



**Quality Management Plan (QMP) and
Quality Assurance Project Plan (QAPP)
for Land-based Testing of BWMS
(AquaStarTM BWMS)**

Project ID: AquaStar Land-based

**Korea Marine Equipment Research Institute
1125-22 Dongsam-dong, Youngdo-gu, Busan, Republic of Korea**

Quality Statement

Full Title of the quality assurance document:	Quality Management Plan (QMP) and Quality Assurance Project Plan (QAPP) for Land-based Testing of BWMS (AquaStar™ BWMS)
Project ID:	AquaStar Land-based
Organizations to which the quality assurance document applies:	1) AQUA Eng. Co., Ltd., Busan, Republic of Korea 2) Korea Marine Equipment Research Institute (KOMERI), Busan, Republic of Korea
Effective date of the quality assurance document:	1 June 2010 to 30 November 2010
Applicant (BWMS developer) :	Gwang-Hyun Lee
Position:	Executive Director
Signature:	
Date:	1 June 2010
Project Director (KOMERI):	Young-Soo Kim
Position:	Team Manager
Signature:	
Date:	1 June 2010

Approval Sheet


Project Director

Name: Young-Soo Kim
Position: Team Manager
Organization: KOMERI

 (Signature) 1 June 2010

Quality Assurance Manager

Name: Jae-Uk Kang
Position: Team manager
Organization: KOMERI

 (Signature) 1 June 2010


Project Co-Director

Name: Jae-Hong Kim
Position: Senior Researcher
Organization: KTR

 (Signature) 1 June 2010

Project Co-Director

Name: Myung-Baek Shon
Position: Team manager
Organization: MEI

 (Signature) 1 June 2010

Field Sampling Manager

Name: Jun-Hyuk Yang
Position: Senior Researcher
Organization: KOMERI

 (Signature) 1 June 2010

Laboratory Manager

Name: Soo-Yeon Im
Position: Researcher
Organization: KOMERI

 (Signature) 1 June 2010

Archive Personnel

Name: Sun Yeon Park
Position: Researcher
Organization: KOMERI

 (Signature) 1 June 2010

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Introduction & Background

AQUA Eng. Co., Ltd. is seeking the Final Approval from the IMO and Type Approval from the Korean Administration for its proprietary AquaStar™ ballast water management system (BWMS). These approvals are being sought in accordance with the *Guidelines for Approval of Ballast Water Management Systems* (G8) and *Procedure for Approval of Ballast Water Management Systems that Make Use of Active Substances* (G9) as adopted by Res. MEPC 174(58) (2008) and 169(57) (2008) of the International Maritime Organization (IMO), respectively.

Part 2, Section 2.1.2 of the G8 and Section 4.2.4 of the G9 require that the testing process for BWMS should include both a Quality Management Plan (QMP) and a Quality Assurance Project Plan (QAPP). The QMP addresses the overall quality management policies and structures of the testing body (including subcontractors and outside laboratories), and the QAPP provides the detailed quality assurance arrangements for the actual testing procedures.

Accordingly, Korea Marine Equipment Research Institute (KOMERI) – a Type Approval Test Organization approved by the Ministry of Land, Transport and Maritime Affairs, Korea – has developed its QMP and QAPP for approvals of BWMS.

As the G8 and G9 do not provide any guideline as to the structure, format and content of the required QMP and QAPP (except referring to generic international standards), and as such guideline is not available from IMO, KOMERI has adopted the following as the standard for the QMP and QAPP:

- US EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5)
- US EPA Guidance for Quality Assurance Project Plans (EPA QA/G-5)
- KOMERI KOLAS Manual, Procedure and direction documents, 2010

Quality Management Plan (QMP)

1. GENERAL

All laboratories at Korean Marine Equipment Research Institute (KOMERI) comply with the Korean Laboratory Accreditation Scheme (KOLAS – www.kolas.go.kr) system for laboratory and research organizations as outlined in Korean national regulations, to ensure the consistency and reliability of laboratory testing results.

All testing and analysis procedures and equipments at KOMERI are certified by the KOLAS to KS ISO/IEC 17025 standard. The certification number for KOMERI is KT-190 and a copy of the current KOLAS accreditation is attached.

The KOLAS accreditation of KOMERI provides the overall QMP (ISO/IEC 17025) and QAPP for all of its testing activities relating to the land-based testing. All external contractors (KTR, MEI) for this project also will follow this QMP and QAPP.

Scope of Certificate for Quality Management System of KOMERI is as follows:

- (1) Management of Test facility
- (2) Field sampling
- (3) Sample transit
- (4) Sample preservation
- (5) Laboratory and Field analysis
- (6) Measurement and Data acquisition



No. 190 (1/33)

CERTIFICATE OF ACCREDITATION

Name of Laboratory : KOREA MARINE EQUIPMENT RESEARCH INSTITUTE

Representative : Kim, Gi-Jung

Address of Headquarters : 1125-22, Dongsam-dong, Youngdo-gu, Busan 606-806, Korea

Address of Laboratory : 1631-10, Songjeong-dong, Gangseo-gu, Busan 618-270, Korea

Duration : Jan. 29, 2008 ~ Jan. 28, 2012

Scope of Accreditation

(Scope of Accreditation is described in the accompanying Annex)

This testing laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025 : 2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated 8 January 2009).

March. 24 , 2010

Huh. Kyung

Administrator,

Korea Laboratory Accreditation Scheme(KOLAS)



No. 190 (33/33)

9. Biological Test

9.006 Aquatic biology

규격번호	규격명
APHA 9215:2005	American Public Health Association (APHA) / Heterotrophic plate count
APHA 10200 C:2005	American Public Health Association (APHA) / Concentration techniques
EPA 445.0:1997	U.S. Environmental Protection Agency (EPA) / In vitro determination of chlorophyll-a and pheophytin-a in marine and freshwater algae by fluorescence
EPA 1600:2006	U.S. Environmental Protection Agency (EPA) / Enterococci in water by membrane filtration using membrane-Enterococcus indoxyl- β -D-glucoside agar (mEI)
EPA 1603:2006	U.S. Environmental Protection Agency (EPA) / Escherichia coli (E. coli) in water by membrane filtration using modified membrane-thermotolerant Escherichia coli agar(Modified mTEC)
UNESCO 4:2003	United Nations Educational, Scientific and Cultural Organization (UNESCO) / Estimating cell numbers
APHA 2540 D:2005	Total Suspended Solids Dried at 103-105°C
APHA 9222 B:2005	Standard Total Coliform Membrane Filter Procedure
ISO 15705:2002	Water quality-Determination of the chemical oxygen demand index (ST-COD)-Small-scale sealed-tube method
APHA 5210 D:2005	Respirometric method

End.

2. RESPONSIBILITY

All activities for achieving approvals of the AquaStar™ BWMS must be controlled under KOMERI's supervision (Figure 1).

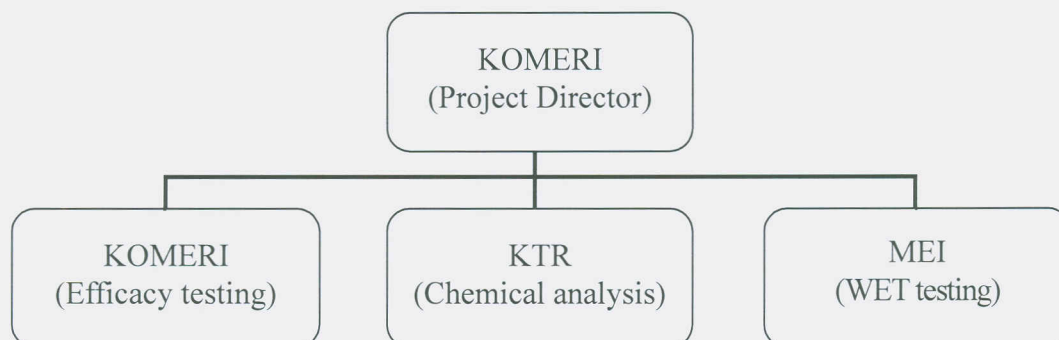


Figure 1. Management arrangement for the AquaStar™ BWMS project

Table 1. Distribution list

Organization	Task	Quality system
KOMERI	Efficacy testing <ul style="list-style-type: none"> - Organism viability ($\geq 50 \mu\text{m}$) - Organism viability ($\geq 10 - 50 \mu\text{m}$) - <i>Escherichia coli</i>/Coliform - Intestinal Enterococci - Heterotrophic bacteria - Toxicogenic <i>V. cholerae</i> (O1, O139) 	<ul style="list-style-type: none"> - ISO/IEC 17025 - Type Approval test organization by Korean government (Ministry of Land, Transport and Maritime affairs)
KTR (sub contractor)	Qualitative and quantitative chemical analysis <ul style="list-style-type: none"> - Active Substances - Relevant Chemicals (by-products) - Other Compounds 	ISO/IEC 17025
MEI (sub contractor)	WET testing <ul style="list-style-type: none"> - Acute toxicity test (Algae/Invertebrate/Fish) - Chronic toxicity test (Algae/Invertebrate/Fish) 	All procedures of MEI comply with the OECD Principles of Good Laboratory Practice (ENV/MC/CHEM(98)17).

The overall project organization for testing in accordance with the G8 and G9 is summarized in Figure 2 and Table 2.

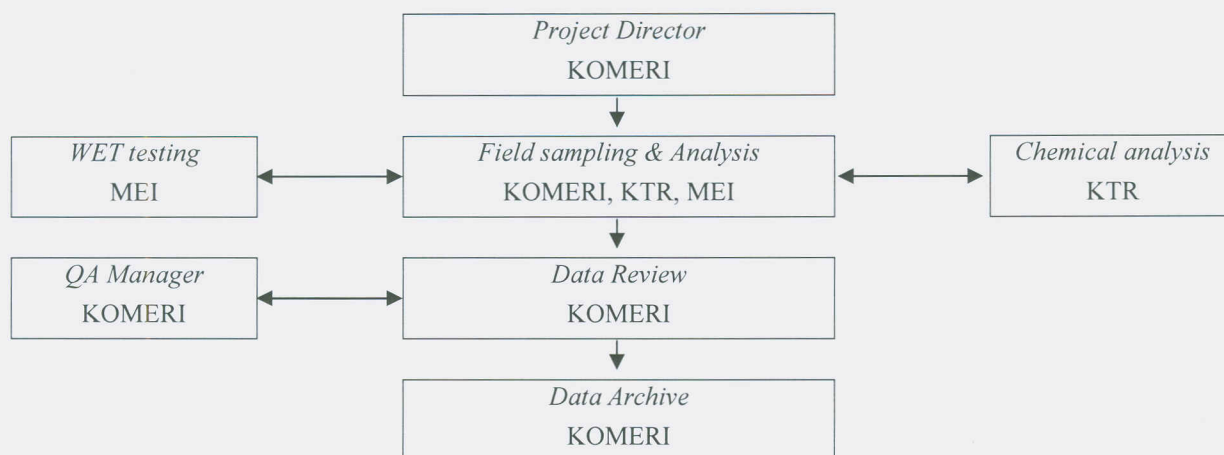


Figure 2. Organization chart outlining the relationship among parties

Table 2. Task responsibilities and contact information

Organization	Name	Responsibility	Contact information
KOMERI	Young-Soo Kim	Project Director	82-51-400-5143 catenatum@komeri.re.kr
	Jae-Uk Kang	Quality Assurance Manager	82-51-400-5170 jukang@komeri.re.kr
	Jun-Hyuk Yang	Field Sampling Manager, Laboratory Technician $\geq 50 \mu\text{m}$ organism	82-51-400-5145 jhyang@komeri.re.kr
	Eun-Ju Seong	Laboratory Technician $\geq 50 \mu\text{m}$ organism	82-51-400-5165 ejseong@komeri.re.kr
	Jeong-Kyeong Park	Laboratory Technician $\geq 10 - 50 \mu\text{m}$ organism	82-51-400-5150 jkipark@komeri.re.kr
	Seon Yeon Park	Archive Personnel, Laboratory Technician $\geq 10 - 50 \mu\text{m}$ organism	82-51-400-5167 sympark@komeri.re.kr
	Hyung Min Park	Laboratory Technician $\geq 10 - 50 \mu\text{m}$ organism	82-51-400-5166 hmpark@komeri.re.kr
	Soo-Yeon Im	Laboratory Manager, Laboratory Technician Bacteria	82-51-400-5151 syylim@komeri.re.kr
	Jun-Hak Lee	Laboratory Technician Bacteria	82-51-400-5149 jhlee@komeri.re.kr
KTR (sub contractor)	Jae-Hong Kim	Project Co-Director	82-52-220-3122 jkh@ktr.or.kr
	Ji-Hyun Lee	Laboratory Manager VOCs/THMs	82-52-220-3127 ljh@ktr.or.kr
	Young-Keun Im	Field Sampling Manager Laboratory Technician TRO/FRO, Sulfide(S ⁻²),	82-52-220-3122 imyk@ktr.or.kr

		O ₃ , ClO ₂ , Density	
	Dong-Youn Kim	Laboratory Technician HAA, HAN	82-220-3150 kdy@ktr.or.kr
	Sung-Wook Pyo	Quality Assurance Manager, reviewer	82-52-220-3011 revianak@ktr.or.kr
MEI (sub contractor)	Myung-Baek Shon	Project Co-Director (Study Director), Laboratory Manager & Technician Aquatic toxicity on Algae	82-70-8630-7121 mbshon@marine- eco.co.kr
	Mi Hyang Kim	Project Co-Director (Study Director), Aquatic toxicity on Invertebrate	82-70-8630-7285 mhkim@marine- eco.co.kr
	Seok Nam Kwak	Project Co-Director (Study Director), Aquatic toxicity on Fish	82-70-8630-7120 snkwak@marine- eco.co.kr
	So Eun Jo	Field Sampling Manager, Laboratory Technician Aquatic toxicity on Invertebrate	82-70-8630-7112 sejo@marine-eco.co.kr
	Tae Won Kim	Field Sampling Manager & Technician, Laboratory Technician Aquatic toxicity on Fish	82-70-8630-7117 twkim@marine- eco.co.kr

Quality Assurance Project Plan (QAPP)

1. PROJECT AND TASK DESCRIPTION

The land-based test facility, which will be controlled by KOMERI during overall period performed this project, is located at #33-3, Jinha-ri, Seosaeng-myeon, Ulju-gun, Ulsan, Korea. All activities associated with operation of the AquaStar™ BWMS, maintenance of the test facility, and performing efficacy testing, chemical analysis and WET testing will be performed under the supervision of KOMERI.

As shown in Figure 3, there are four simulated ballast tanks (T-01, T-02, T-03 and T-04) in the test facility. The tank capacity of T-02, T-03 and T-04 has the identical volume of about 260 m³ respectively, except for about 190 m³ as tank capacity of T-01. The capacity of ballast or de-ballast pump is 200 ~ 250 m³/h for efficacy testing, chemical analysis and WET testing. All sampling ports installed ballast or de-ballast pipe line at this facility are “L”-shaped to ensure representative samples of treated and control water, being oriented such that the opening is facing upstream and concentric to ballast or de-ballast pipe line. The automatic sampling device with a digital flow meter will be used to collect samples of treated and control water. All materials of tank, valves, piping and paints applied at this facility are the same as used in vessel.

After completion of each test cycle, used ballast tanks will be cleaned by high pressure washes with fresh water. Also, used piping lines and units will be washed by circulating with fresh water. By cleaning, any products or sediments generated by tests could be removed. This procedure for cleaning will be conducted under KOMERI's supervision.



Figure 3. The land-based test facility of the AquaStar™ BWMS

1.1 Operation procedure of the AquaStar™ BWMS

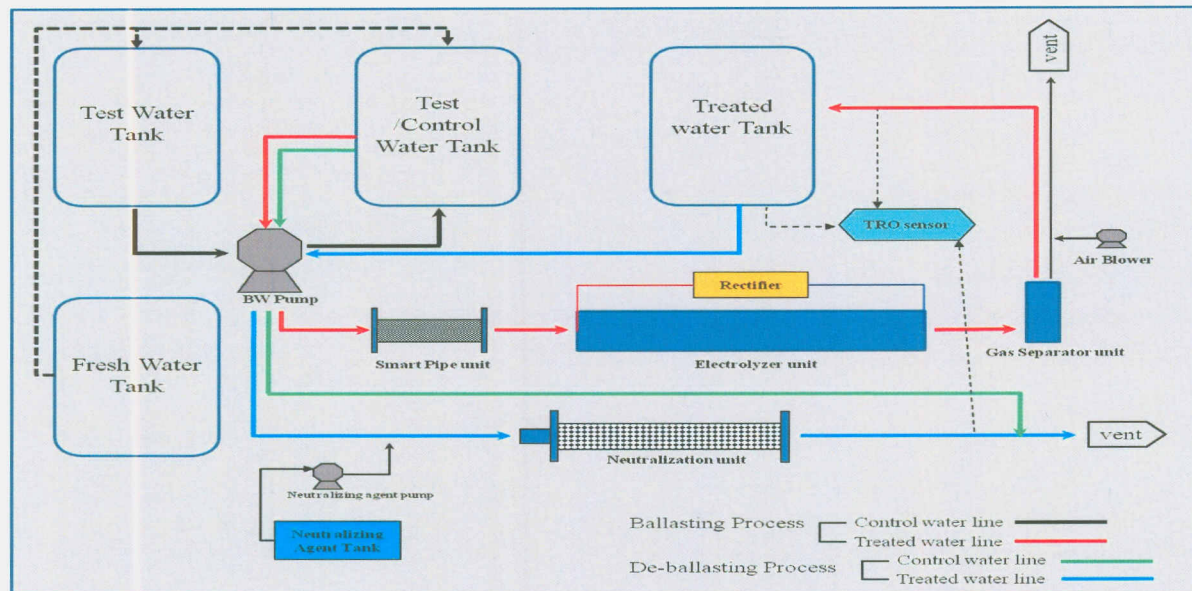


Figure 4. Flow diagram of the AquaStar™ BWMS

The flow diagrams of treated water and control water during ballasting are shown in Figure 5 and 6, respectively.

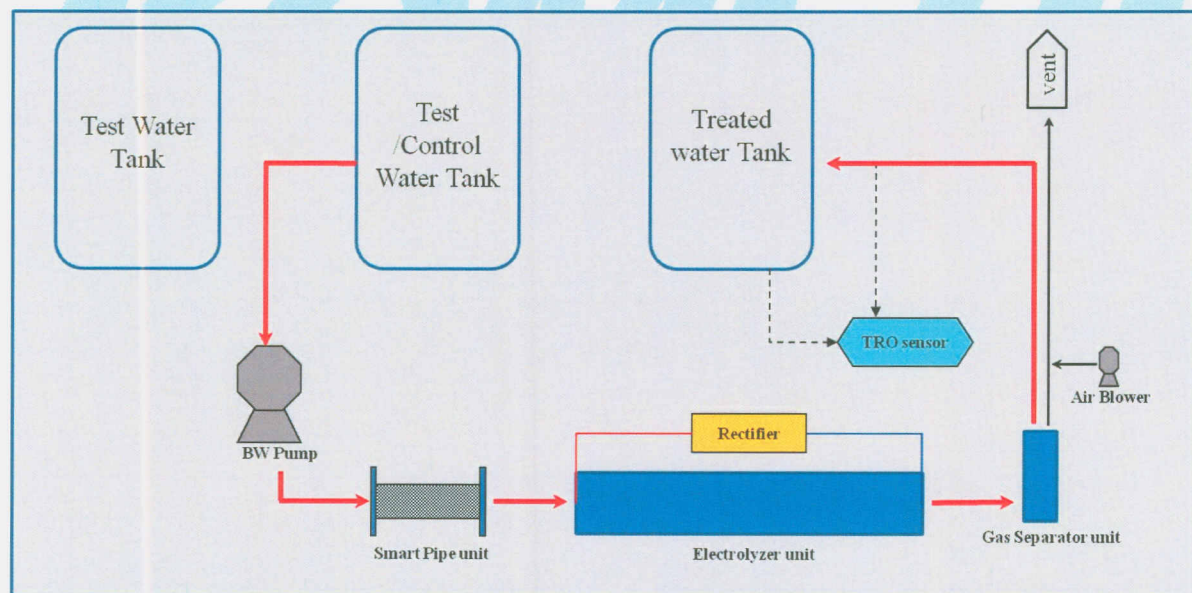


Figure 5. Treated water flow diagram of the AquaStar™ BWMS during ballating (red line)

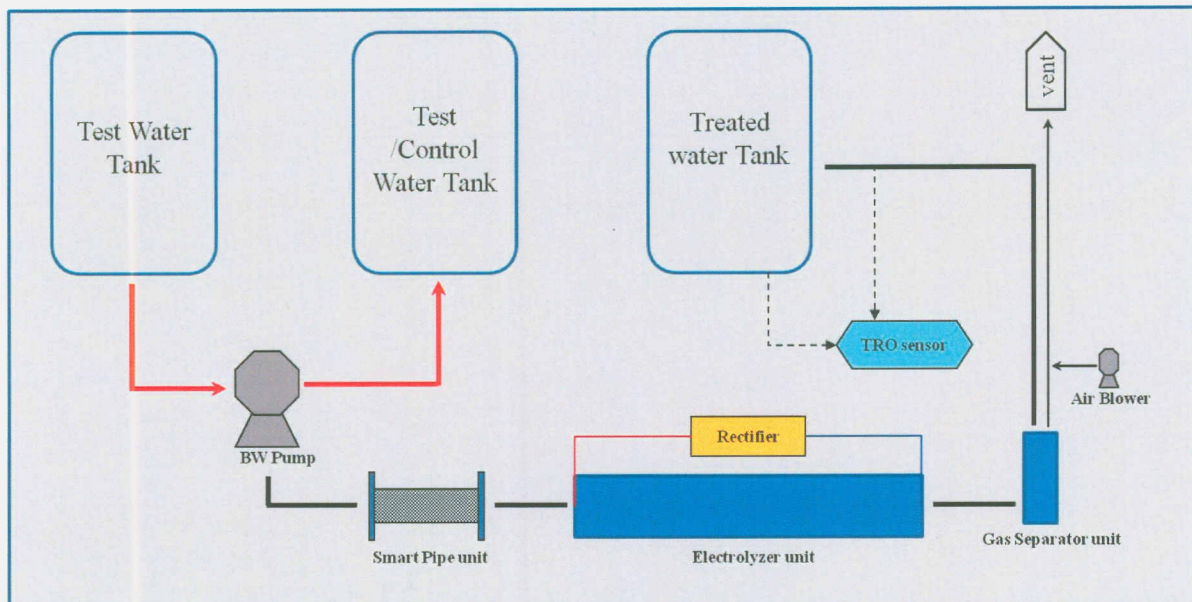


Figure 6. Control water flow diagram of the AquaStar™ BWMS during ballasting (red line)

The flow diagrams of treated water and control water during de-ballasting are shown in Figure 7 and 8, respectively.

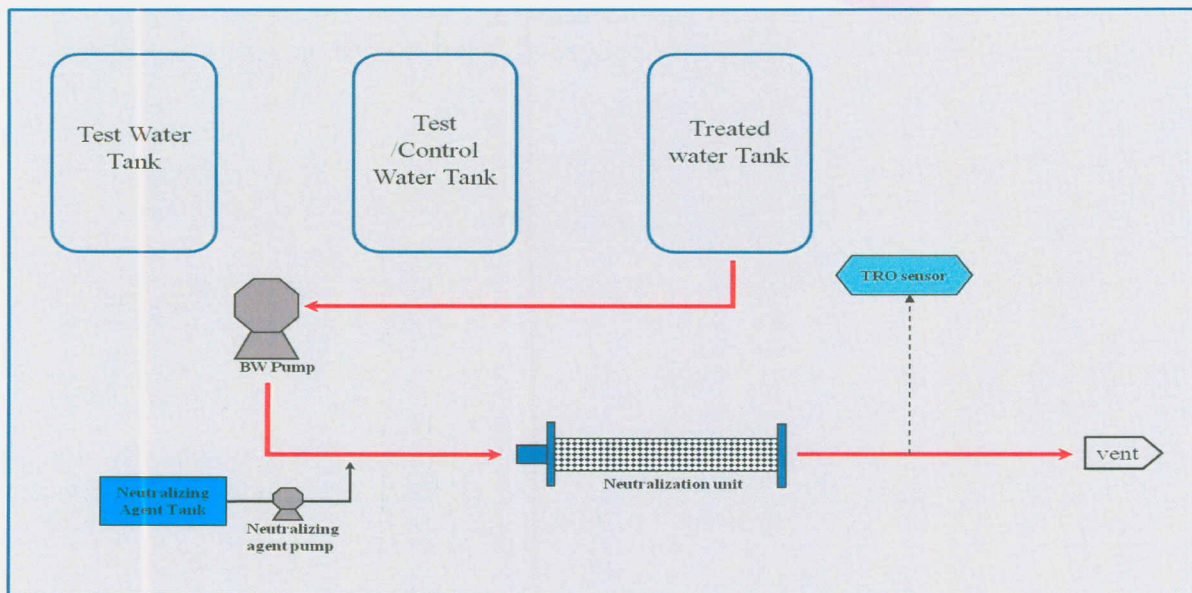


Figure 7. Treated water flow diagram of the AquaStar™ BWMS during de-ballasting (red line)

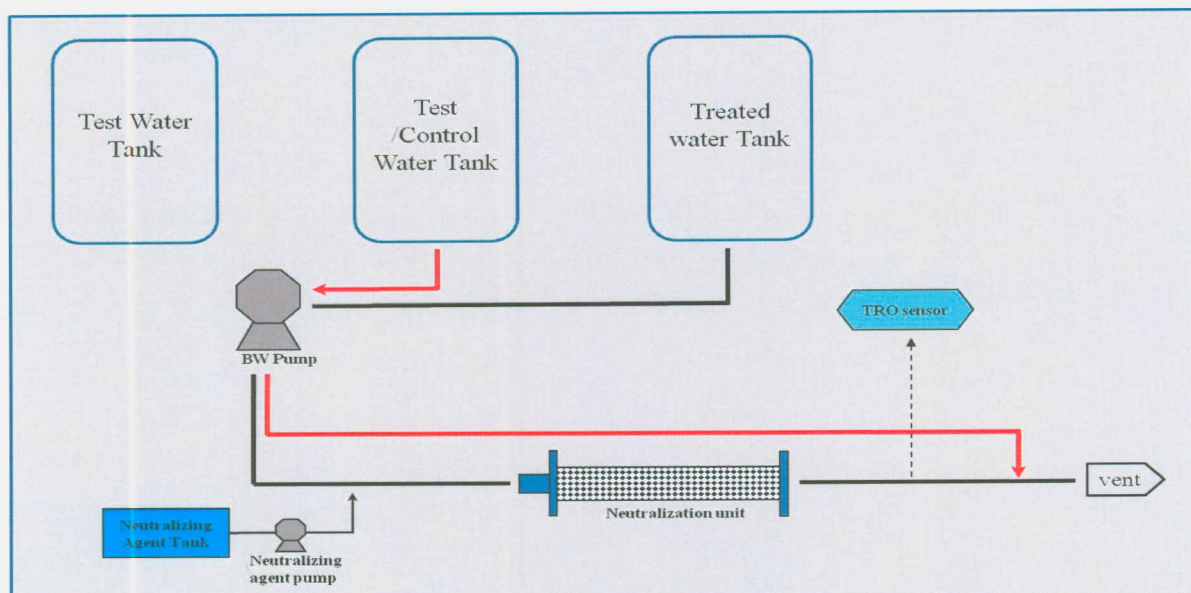


Figure 8. Control water flow diagram of the AquaStar™ BWMS during de-ballasting (red line)

1.2 Task

The land-based testing of the AquaStar™ BWMS in accordance with the G8 and G9 is composed of the following tasks:

- (1) Efficacy testing, chemical analysis and WET testing of the AquaStar™ BWMS
- (2) Reporting and evaluation of test results

KOMERI has the ultimate responsibility for the tasks above. As supporting institutes, Korea Testing & Research Institute (KTR) and Marine Eco-technology Institute (MEI) Co., Ltd. will participate in this project under KOMERI's supervision to conduct the following tasks:

- (1) KTR will conduct *in-situ* and laboratory analysis of control and treated water. KTR will periodically participate in the 'Inter-laboratory Comparison Test' to maintain the quality assurance.
- (2) MEI will carry out the WET testing for discharge control and discharge treated water.

1.3 Test schedule and responsibility

The test schedule of this project is as follow;

Table 3. Test schedule and responsibility

Test salinity (PSU)	Test cycle	Year / Month / Day		Responsibility		
		Ballasting	de-Ballasting	KOMERI	KTR	MEI
> 32	1	2010/06/23	2010/06/28	O		
	2	2010/06/30	2010/07/05	O		O ^a
	3	2010/07/07	2010/07/12	O	O ^b	O
	4	2010/07/14	2010/07/19	O		O
	5	2010/07/21	2010/07/26	O		O
3 - 32	6	2010/08/11	2010/08/16	O		

	7	2010/08/25	2010/08/30	O		O
	8	2010/09/09	2010/09/14	O	O	O
	9	2010/09/15	2010/09/20	O		O
	10	2010/09/29	2010/10/04	O		

^a WET testing will be carried out in 2~5 test cycles (seawater) and 7~9 test cycles (brackish water).

^b Chemical analysis will be carried out on day 0, day 1 and day 5.

There may be some changes to the schedule due to failure and malfunction of equipment and/or instrument, result of the test, a natural disaster and so on. When the test schedule is changed, it will be notified and provided with an appendix including reason of the change.

KOMERI

2. MEASUREMENT AND DATA ACQUISITION

2.1 Test process design

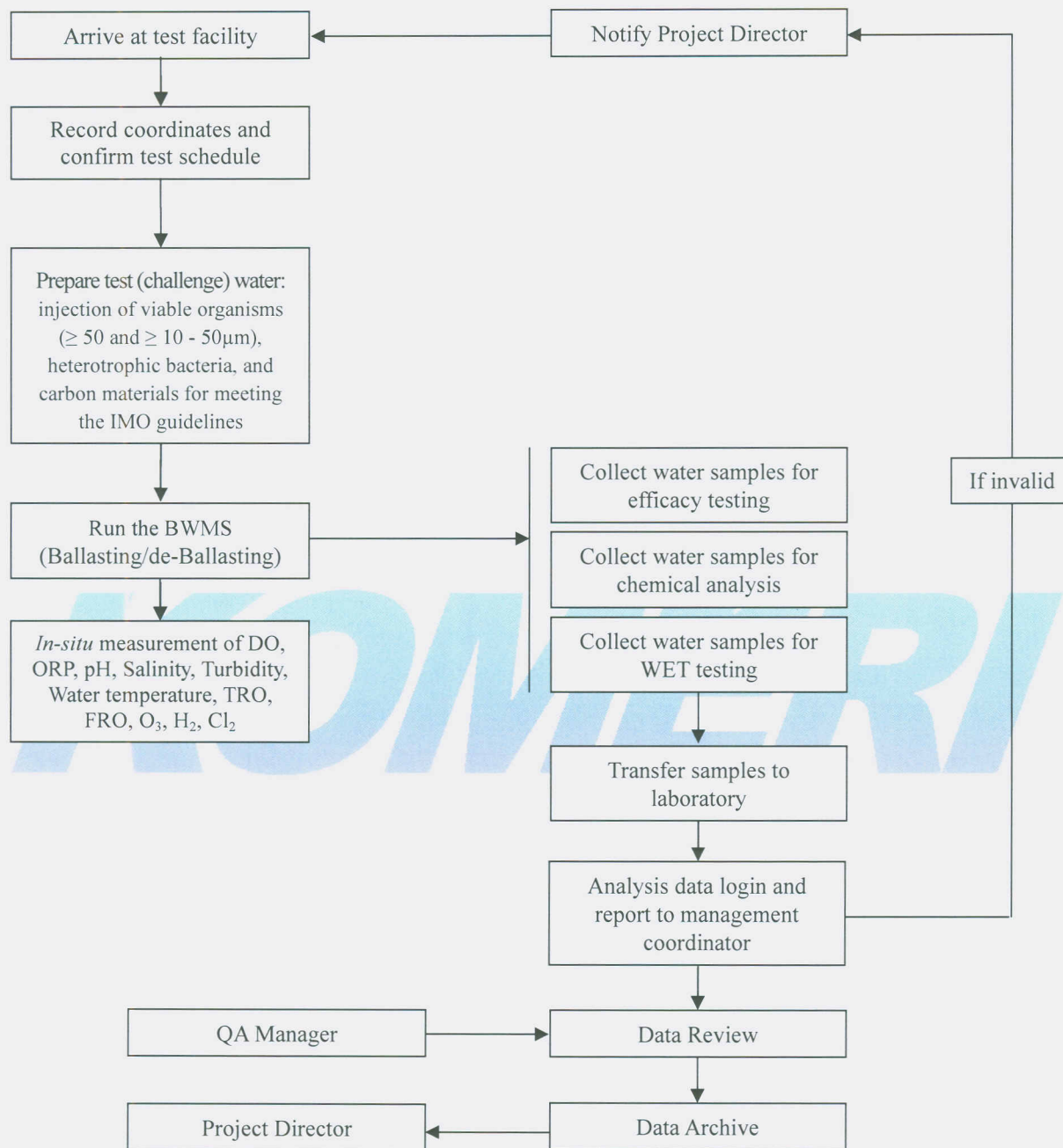


Figure 9. Test activities and data management process

2.2 Preparation of test (challenge) water

2.2.1 Viable organisms

Natural and cultured test organisms will be prepared for satisfying the requirements of test (challenge) water in accordance with the G8. Cultured test organisms for test (challenge) water will be prepared as below (Table 4) and added to test (challenge) water through the rooftop manholes of Tank-2 and Tank-3.

Table 4. Concentration, injection volume and species of cultured test organisms

Test salinity (PSU)	≥ 50 µm organisms			≥ 10 - 50 µm organisms		
	Organism	Density (inds./mL)	Volume (L)	Organism	Density (inds./mL)	Volume (L)
> 32	<i>Artemia salina</i>	800	150	<i>Tetraselmis suecica</i>	1.65×10^6	3,000
	<i>Brachionus plicatilis</i>	5,500	20			
3 - 32	<i>Artemia salina</i>	700	200	<i>Tetraselmis suecica</i>	1.50×10^6	1,350
	<i>Brachionus plicatilis</i>	4,500	10			

*Cultured test organism should be alive more than 90% of total injected volume after 1 hr of injection in test (challenge) water tank.

2.2.2 Dissolved organic carbon (DOC), particle organic carbon (POC) and total suspended solid (TSS)

Glucose and starch will be added to test water to meet the required conditions of DOC, POC and TSS in accordance with the G8 (Table 5). Dissolved glucose and starch will be prepared and added to test water through the rooftop manholes of Tank-2 and Tank-3. The nominal concentrations of glucose and starch in test water will be injected as follows.

Table 5. Weight of glucose and starch supplied for DOC, POC and TSS

Test salinity (PSU)	Glucose (g/m ³)	Starch (g/m ³)
> 32	4.4	12
3 - 32	10	66.4

2.3 Sampling

Sample collection plans will be applied during the sample collection periods. These plans will include detailed information on the sample locations, and the types of samples to be collected. The Project Director will apply the sample collection plan and brief the sample collection team on the objectives of the sampling.

2.3.1 Sampling information

Table 6. Sampling information

Sample	Sampling location	Total volume of sample (L)		
		KOMERI ^a	KTR ^b	MEI ^c
Test (challenge) water	S1	50	20	-
Control water during ballasting on day 0	S2	150	20	-
Treated water during ballasting on day 0	S3	3,100	20	-
Control water during ballasting on day 1	S4	-	20	-
Treated water during ballasting on day 1	S5	-	20	-
Control water during de-ballasting on day 5	S6	150	20	800
Treated water during de-ballasting on day 5	S7	3,100	20	400
Gas during ballasting and de-ballasting	G1, G2	-	30	-

^a KOMERI conducts efficacy testing (basic water parameters, viable organisms, bacteria). Basic water parameters are pH, water temperature, ORP, salinity, DO and turbidity. Sampling will be conducted at beginning, middle and end.

^b KTR conducts chemical analysis. Sampling will be conducted at middle.

^c MEI conducts WET testing. Sampling will be conducted at middle.

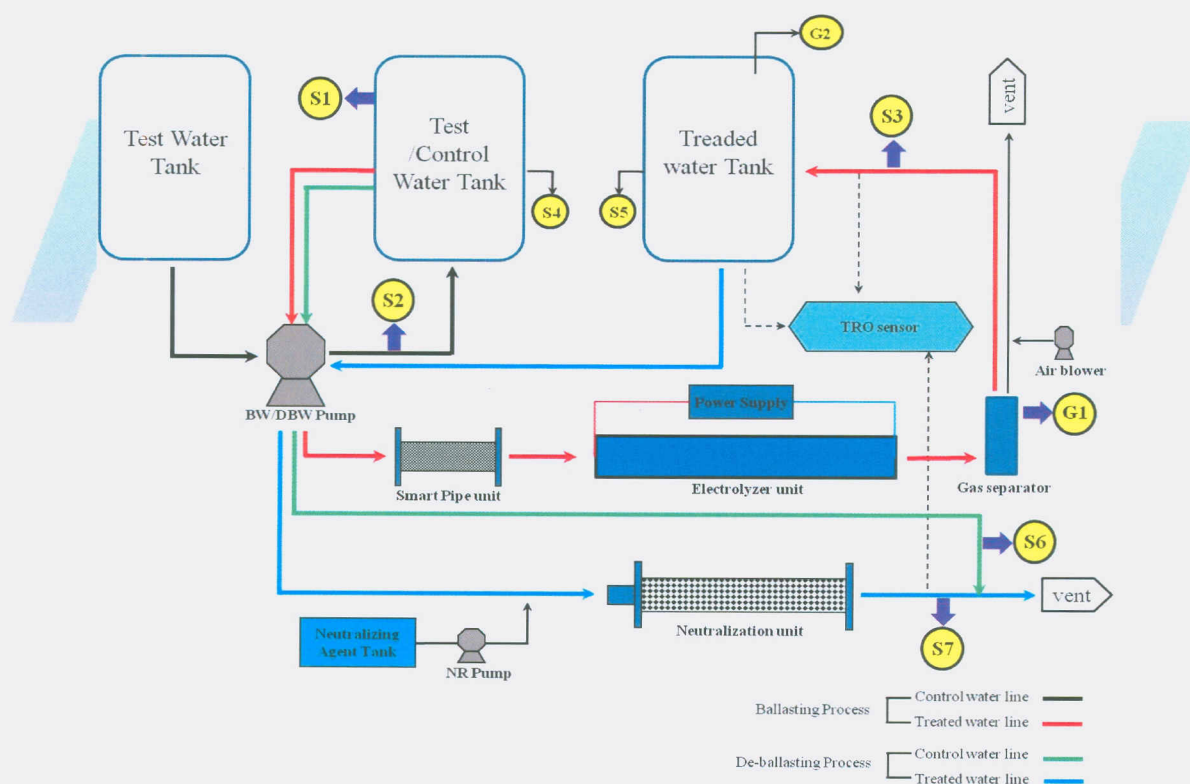


Figure 10. Sampling location

Table 7. Sample tag

Sample		Elapsed time		
		Day 0	Day 1	Day 5
Test (challenge) water		AS-S1D0-1	-	-
Control water	B	AS-S2BD0-1	AS-S4D1-1	AS-S6BD5-1

	M	AS-S2MD0-1		AS-S6MD5-1
	E	AS-S2ED0-1		AS-S6ED5-1
Treated water	Before ^a	-	-	AS-S5D5-1
	B	AS-S3BD0-1	AS-S5D1-1	AS-S7BD5-1
	M	AS-S3MD0-1		AS-S7MD5-1
	E	AS-S3ED0-1		AS-S7ED5-1
Gas sampling		AS-G1D0-1 /AS-G2D0-1	AS-G2D1-1	AS-G2D5-1

^a Before Neutralization (KTR)

2.3.2 Sampling methods

Sampling will be performed according to Water quality-Sampling-Part 3: Guidance on the preservation (ISO 5667-3, 2003), Standard Methods for the Examination of Water and Wastewater (APHA, 2005) and Coastal 2000 Northeast Component 'Field Operation Manual' (US EPA, 2000).

(1) Sampling for efficacy test

Sample should be collected in HDPE bottle or sterilized pack. All sampling bottle must be rigorously cleaned and rinsed with ultra-pure water. And then all bottles and packs will be attached identification tags.

- ***Viable organisms***

≥ 50 µm organisms will be collected using a plankton net of 45 µm diagonal mesh size immersed in a 1 m³ of water tank. The plankton net will be rinsed with filtered ballast water once use. Organisms will be concentrated from 1 m³ of treated water and 20 L of control water.

≥ 10 - 50 µm organisms will be collected using a plankton net of 7~8 µm diagonal mesh size of immersed in a 1 m³ of water tank. The plankton net will be rinsed with filtered ballast water once use. Organisms will be properly concentrated from 10 L of treated water and 1 L of control water.

All samples will be placed in a cooler box , which are electronically adjusted to the ambient water temperature for plankton, and then transferred to the laboratory by car within 2 hours after sampling; sample analysis will be commenced within an hour of arrival at the laboratory.

- ***Bacteria***

1 or 2 L sterilized disposable polyethylene (PE) packs will be used for each sample collection. After sample collection, each sample bottle will be put into a 4 °C cooler box to ensure proper maintenance of storage temperature and care will be taken to prevent sample bottles from being totally immersed in water during transit. Sample analysis should begin immediately and preferably within 2 hours of collection. The maximum transport time to the laboratory is 2 hours.

- ***DOC/POC***

Because of the possibility that oxidation or bacterial decomposition of dissolved components might occur in collected samples, the time between sample collection and the start of analysis should be minimized. Also, samples should be kept cool (4 °C) and protected from sunlight and atmospheric oxygen. In instances where analysis cannot be performed within 2 hours from sampling time, the sample will be acidified ($\text{pH} < 2$) with HCl or H_2SO_4 (7 days, ISO 5667-3).

(2) Sampling for chemical analysis

- ***Bromide/Chlorate/Chloride***

Sample should be collected in plastic or glass bottle. All bottles must be thoroughly cleaned and rinsed with reagent water. Volume collected should be sufficient to ensure a representative sample, allow for replicate analyses, if required, and minimize waste disposal.

- Bromide, Chloride (no preservation required, holding time-28 days)
- Chlorate (50 mg/L ethylenediamine, holding time-28 days)

- ***VOCs/THMs***

Collect the sample normally by immersion, by filling the bottle or the vial completely, discarding this water, refilling and putting the stopper so as to leave no headspace. Loss of volatile compounds through degassing of the sample should be avoided. Slowly fill the bottle at the sampling point until water overflows, avoiding turbulence. If reactions between free halogens and organic matters in the sample, which generate tri-halogenated methanes (THMs), need to be eliminated, it is necessary to add an excess of sodium thiosulfate to the sampling bottle or vial after rinsing the bottle or vial prior to sampling (0.1 - 0.2 mL of 30 g/L solution).

- ***AOX***

Sample will be adjusted by adding sodium sulfite solution (5 mL) and nitric acid (1 mL) to a glass bottle. 500 mL sample will be collected without any space and air-tightly sealed. All samples will be collected in the same manner. Sample will be collected in glass bottle by filling the bottle completely, with the sample. The sample collected at the test site will be transported in an icebox with an inner temperature range of 2 ~ 4 °C. All samples will be analyzed within 7 days.

- ***Bromate***

Use clean polyethylene vessels for sampling. Avoid any further formation of bromated after sampling, by removing immediately any remaining ozone. For example, add 50 mg of ethylenediamine to 1 L samples immediately after sampling. Store the sample in a polyethylene vessel at 2 °C to 6 °C until the analysis.

- ***HANs***

Glass vials with Teflon-lined caps are preferable for sampling and the storage of sample. Add 1 g of a buffer/dechlorination agent mixture, which is made by mixing 1.2 g dechlorination agent and of 200 g of the phosphate buffer, 60 mL sample. The sample must be chilled to 4°C on the day of collection and maintained at that temperature until analysis. Field sample that will not arrive at the laboratory on the day of collection must be packaged for shipment with sufficient ice to ensure that their temperatures will 4 °C until arrival at the laboratory. All samples should be analyzed within 14 days (This applies to either MTBE or pentane extracts).

*200 g of the phosphate buffer: 2 g Na_2HPO_4 + 198 g KH_2PO_4

*Dechlorination agent: ammonium chloride (HANs), sodium sulfite (chloral hydrate)

- ***HAAs***

Glass vials with Teflon-lined caps are preferable for sampling and the storage of samples. Add 100 mg ammonium chloride (NH_4Cl) to 1 L samples. Samples must be iced or refrigerated at 4 °C and maintained at those conditions away from light until extraction. Holding studies performed to date have suggested that, in samples preserved with NH_4Cl , samples are stable for up to 14 days.

- ***Halogenated phenols***

Collect sample in 1 L amber glass bottles fitted with a screw cap lined with PTFE. If residual chlorine is present, add 80 mg sodium thiosulfate ($\text{Na}_2\text{S}_2\text{O}_3$) per liter of sample and mix well. Ice all samples or refrigerate them at 4 °C from time of collection until extraction. Extract samples within 7 days of collection and analysis completely within 40

days of extraction.

(3) Sampling for WET testing

Discharge control and treated water sample will be collected in 200 L PE container with cap as to leave no headspace to protect from sunlight and contact with the atmosphere. Sample volumes are 900 L for discharge control water and 400 L for discharge treated water, respectively. Samples will be placed in vehicle with refrigerator to minimize the temperature change and transported to the laboratory. All samples will be filtered through 1 μm CP filter (Chisso Filter, Japan) to remove debris before to use. The concentration of the discharge treated water for toxicity testing is diluted using the discharged control water as the crude liquid. The gradient series (six concentrations of the archive water) for toxicity test including 0.00% (only discharged control water) and 100.00% (only discharged treated water) are arranged for the final definitive experiment.

2.3.3 Sample handling and custody

In order to minimize the possibility of contamination and introduction of artifacts, a procedure will be developed to collect, transport and preserve the samples for analysis. Special care will be taken to prevent the volatilization from filtered samples, to prevent adverse temperature-effect on water samples, as well as to prevent contamination of collected samples with ubiquitous gaseous air pollutants.

Specific procedures to ensure the integrity of the collected samples will be outlined in the SOPs developed for each instrument. However these should include the necessary procedures for ensuring sample validity by:

- Preparation of sampling material, including procedures to clean water samples, loading water samples into sampling apparatus, and transport of sampling media to field locations
- Storage of sampling media once removed from sampling location including sealing procedures and temperature requirements for transportation from field locations to laboratory
- Archiving of sampling material until the analysis can be performed including prevention of photochemical and temperature changes
- Requirement for removing samples from archive for analysis that preserve sample integrity

Sample custody will be documented with sample log sheet for each water sample, which will track the lifetime from preparation and cleaning, deployment to the laboratories, laboratory archiving until analysis and data reporting.

Samples are logged into the login notebook after arrival at the laboratory, and assigned a laboratory sample number.

2.4 Analysis methods

Accuracy of laboratory analysis will be assessed for compliance with the criteria established in Korea Laboratory Accreditation Scheme (KOLAS) for efficacy testing and chemical analysis and appropriate system (OECD GLP system) for WET testing. And all laboratory testing and analysis are undertaken by scientific and technical staff who belong to KOMERI, KTR and MEI.

Table 8. Laboratory analysis methods

Parameter	Method	
Basic water parameter		
Salinity	APHA Standard Method ^a 2520 B	
Dissolved oxygen	ASTM D888-09 Test Method C	
Water Temperature	APHA Standard Method 2550	
pH	APHA Standard Method 4500-H ⁺ B	
Oxidation-Reduction Potential	APHA Standard Method 2580	
TOC (DOC/POC)	ISO 8245:1999	
Total suspended solid	APHA Standard Method 2540 D	
Turbidity	APHA Standard Method 2130 B	
Efficacy testing		
≥ 50 μm Organism	Fleming & Coughlan (1978) ^b US EPA 600/R-10/146 (2010) ^c APHA Standard Method 10200 C	
≥ 10 - 50 μm Organism	Anja <i>et al.</i> (2005) ^d APHA Standard Method 10200 C Manual and Guide, UNESCO (2005) UNESCO 4 (2003) US EPA 445.0:1997	
Heterotrophic bacteria	APHA Standard Method 9215	
Coliform	APHA Standard Method 9222 B	
<i>Escherichia coli</i>	US EPA 1603:2009	
Intestinal Enterococci	US EPA 1600:2009	
Toxicogenic <i>Vibrio cholerae</i> (O1, O139)	APHA Standard Method 9260 H	
Chemical analysis		
AOX	ISO 9562:2004	
Bromate	ISO 15061:2001	
Bromide/Chlorate/Chloride	US EPA 300.1:1997	
VOCs/THMs	US EPA 524.2:1995	
Halogenated Phenols	US EPA 8041A:2007	
HAAs	US EPA 552.2:1995	
HANs	US EPA 551.1:1995	
TRO/FRO	ISO 7393-2:1985	
Density	ISO 15212-1:1998 Oscillation-type density meters-Part 1	
WET testing		
Acute/Chronic	Algae	OECD 201
	Invertebrate	ASTM E1440-91/Janssen et al., 1994 ^e
	Fish	OECD203/212

^a Standard Methods. 2005. In: A.D Eaton, L.S Clesceri, E.W Rice, A.E Greenberg (eds), *Standard Methods for the Examination of Water and Wastewater*. Baltimore, Maryland. APHA, AWWA and WEF.

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- ^b Fleming, J.M., Coughlan, J. 1978. Preservation of vitally stained zooplankton for live/dead sorting. *Estuaries* (1) 135-137.
- ^c US EPA 600/R-10/146. 2010. Protocol for the Verification of Ballast Water Treatment Technologies. Section 5.4.6.4. p45.
- ^d Anja S, T. Cheryl, S. James, S. Kristin. 2005. Application of Alamar blue/5-carboxyfluorescein diacetate acetoxymethyl ester as a noninvasive cell viability assay in primary hepatocytes from rainbow trout. *Analytical Biochemistry*. (344) 76-85.
- ^e Janssen C.R., G. Persoone and T. W. Snell. 1994. Cyst-based toxicity tests. VIII. Short-chronic toxicity tests with the freshwater rotifer *Brachionus calyciflorus*. *Aquatic Toxicology*, 28, 243-258.

2.5 Data acquisition

2.5.1 Documentation and records

- QAPP

The Master Copy of the QAPP will be kept in electronic copy at a security data server at KOMERI.

The Quality Assurance Manager, Jae-Uk Kang, is the overall Quality Manager for this QAPP and has responsibility for controlling its currency and ensuring that all personnel listed in Approval Sheet have up-to-date, controlled copies of the document, sent by email as a Read Only (non-changeable) PDF file. Record of Distribution is to be kept as hard copy on file no. [Data file for BWMS Land-based test AQUA AquaStarTM] and saved in electronic copy at file directory [D:\BWMS\AQUA AquaStarTM\Land\KOMERI\QAPP].

The QA Manager will then ensure that the updated QAPP is distributed to all personnel listed in Approval Sheet, again by email as a Read Only (non-changeable) PDF file, and that the Record of Distribution is completed. Personnel are to be confirmed by email to the Project Director/QA Manager when they receive updated versions of the QAPP, which are to be filed as per paragraph. Such confirmation e-mails are to be printed and filed as hard copy on file no. [Data file for BWMS Land-based test AQUA AquaStarTM] and saved in electronic copy at file directory [D:\BWMS\AQUA AquaStarTM\Land\KOMERI\QAPP].

Project progress meetings of each co-Director involved in the G9 testing will be held at KOMERI periodically, and agreed changes and updates at those meetings will be applied to this project's QAPP.

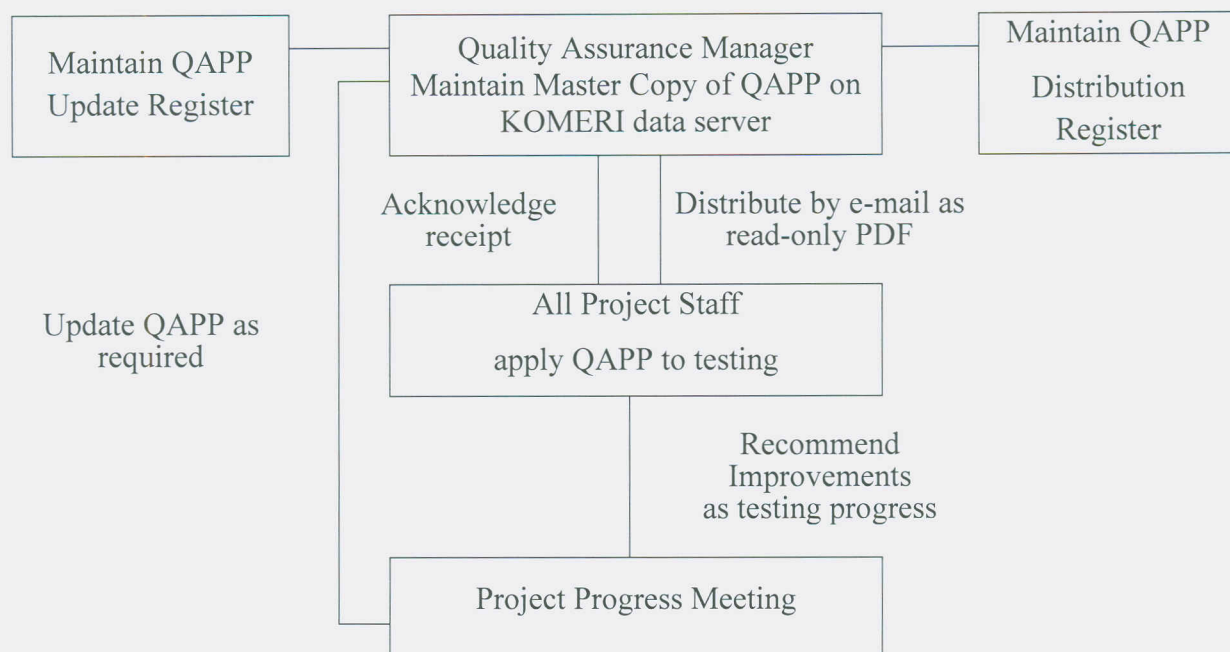


Figure 11. QAPP document control process

- **Field sample records**

Field sample records are to be accompanied by a Chain of Custody (COC) format at each sampling time, and then bound for keeping.

- **System monitoring and operation records**

All operation data including water temperature, flow-rate and electric power consumption are to be accompanied by a Chain of Custody (COC) format at each test cycle, and then bound for keeping.

- **Chain of custody (COC) records**

The transport of all samples from field sampling to the laboratory for analysis is to be accompanied by a COC. The COC is to be completed at each step in the transport chain, with each party in the transport exchange keeping a copy of the Record; which is to be filed by each party for future reference if necessary.

- **Laboratory raw data records**

Analysis raw data log sheets are used for data recording and are to be accompanied by a COC format at each time of analysis, and then bound for keeping.

2.5.2 Data management

- **Data recording**

Data are transposed from field notebooks to an electronic data-base, and from laboratory reports to an electronic database.

- **Data validation**

Data are validated to ensure that the system performs the intended function consistently, reliably, and accurately in generating the data in accordance with KOLAS (ISO/IEC 17025).

- **Data transformation**

It is expected that data transformations made during this investigation will be relatively simplistic and all calculations made during data transformation will be checked 100% prior to dissemination of the transformed information.

- **Data transmittal**

During the transfer of data from one place (field notebook or data report) to another (electronic data spreadsheet) the data will be copied and checked by one individual and then checked 100% by a second individual to ensure accuracy.

- **Data reduction**

Raw data from field measurements are recorded directly in field notebooks or on sample log. If errors are made, results will be legibly crossed out, legibly signed and dated by the person recording the data, and corrected in a space adjacent to the original entry. Logbooks will be periodically reviewed by the Project Director and QA Manager to ensure that records are complete, accurate, and legible. Reduction of current water quality test data will be made by entering all field collected data in an EXCEL[®] computer spreadsheet.

Laboratory data reduction procedures will be performed according to the following protocol. All information related to analyses will be documented in controlled laboratory logbooks, instrument printouts, or other approved forms. All entries that are not generated by an automated data system will be made neat and legible in waterproof ink. Corrections will be made by drawing a single red line with personnel signature through the error and entering the correct information adjacent to the cross out. All changes will be legibly signed, dated, and if appropriate, accompanied by a brief explanation. Analytical laboratory records will be reviewed by the Section Supervisors on a regular basis and by the laboratory QA/QC officer periodically, to verify adherences to documentation requirements.

- **Data analysis**

The data generated during initial test periods in this project will be used to calculate the efficiency of ballast water treatment system during the test periods. Treatment efficiency will be used to calculate charging/discharging to and from the ballast tank, and to verify the system durability and/or stability.

- **Data tracking**

Data will be recorded in the field notebooks and upon return completion of the associated data collection information will be transposed to an electronic spreadsheet or Acrobat Reader (PDF) format. Copies of field data will be made and stored in project file on a daily basis. Laboratory data will also be transposed to an electronic spreadsheet format upon receipt.

- **Data storage and retrieval**

Data will be maintained in electronic format using MS EXCEL for data analysis and presentation purposes. Backup copies of all data files will be made intermittently throughout the project and upon completion of the project, a DVD containing all electronic data will be produced with copies available for distribution.

- **Data release**

Prior to being released as final, laboratory data will proceed through a tiered review process. Each analyst will be responsible for reviewing the analysis and QC data that he/she has generated. As part of this review, the analyst will verify that:

- The appropriate methodology was used,
- Instrumentation was functioning properly,
- QC analysis were performed at the proper frequency and the analysis met the acceptance criteria,
- Samples were analyzed within due time,
- All data were generated within the calibration range,
- Matrix interference problems were confirmed,
- Method-specific analysis requirements were met, and
- Calculations, dilution factors, and detection limits were verified.

Prior to releasing the final data, the section supervisor will review the data to:

- Verify the appropriate methodology was used,
- Verify QC analysis were performed at the proper frequency and the analysis met the acceptance criteria,
- Verify samples were analyzed within due time,

- Review and document problems encountered during the analysis.

The final data report will be reviewed and approved by Project Director and QA Manager prior to its release.

2.5.3 Data validation and usability

(1) Data review

Once these goals and objectives are evaluated and approved the AquaStar™ BWMS, analysis data quality will be assessed to determine if the objectives have been met. In addition, the data will be reviewed by KOMERI's QA Manager for indications of interference of results by sample matrices, cross contamination during sampling, cross contamination in the laboratory, and sample preservation and storage anomalies.

(2) Validation and verification methods

- *Efficacy testing*

The procedures used to evaluate field and laboratory analysis data will include checking procedures used in the field, ensuring that field measurement equipment was properly calibrated, checking for transcription errors, and comparing the data to historic data or verifying its 'reasonableness'. Evaluation of field data will be the responsibility of the Project Director or his designee.

An independent assessment of the data will be performed by KOMERI. The overall completeness of the data package will be evaluated. Completeness checks will be administrated on all data to determine whether the deliverables in accordance with the requirements specified in the QAPP are present.

Accuracy of laboratory analysis will be assessed for compliance with the criteria established in section Calibration and Quality Control Check of the Final Report using the analysis results of method blanks and DOC/POC samples. The percent recovery (%R) for DOC/POC samples will be determined according to the following equation:

$$\%R = [(Amount\ in\ spiked\ sample \times Amount\ in\ sample) / Known\ amount\ added] \times 100$$

%R for DOC/POC will be determined according to the following equation:

$$\%R = (Experimental\ concentration / Known\ amount\ added) \times 100$$

For unknown viable organisms (≥ 50 and $\geq 10 - 50\ \mu m$), if cannot be identified in the samples should be sent to an appropriate agency for identification by an expert taxonomist where

possible. It might be noted here that smaller phytoplankton are poorly known taxonomically and it may not be possible to identify these. Data from expert taxonomists are compared with archived KOMERI data for confirmation.

Precision of quantitative methods (APHA Standard Methods 9020B) will be used for data assessment of heterotrophic bacteria.

- Perform duplicate analysis on the first 2 positive samples of each type, with each set of duplicates analyzed by a single analyst. Duplicate analysis are recorded as D_1 and D_2 .
- Calculate the logarithm of each result. If either of a set of duplicate results is <1 , add 1 to both values before calculating the logarithms.
- Calculate the range (R) for each pair of transformed duplicates as the mean (\bar{R}) of these ranges.

Thereafter, analyze 10 % of routine samples in duplicate.

- ***Chemical analysis***

Test methods applied ISO, ASTM, Standard method, OECD Guideline. If KTR develops or introduces new test methods for the autonomous use, validation and verification of test methods should be conducted according to KTR QP-17.

KOMERI

3. QUALITY ASSURANCE SYSTEM

3.1 Quality assurance objectives

3.1.1 Efficacy testing

Quality assurance objectives for KOMERI are listed in Table 9.

Table 9. Quality assurance objectives of KOMERI

Analysis item	Unit	Method detection limit	Concentration range	Precision objective	Accuracy objective
Water Temperature	°C	NA	-5 ~ 50	0.01	± 0.1
Salinity	PSU	1.0	≤ 100	1%	± 1.0
pH	pH unit	0.0	0 ~ 14	± 0.01	± 0.2
Dissolved oxygen	mg/L	0.1 0.2	< 8 mg/L > 8 mg/L	0.01	± 0.1 ± 0.2
ORP	mV	1.0	-999 ~ 999	1.0	± 20
Turbidity	NTU	0.1	0 ~ 100 NTU 100 ~ 400 NTU 400 ~ 3000 NTU	0.1 - 1.0	1% 3% 5%
Total suspended solid	mg/L	0.1	NA	5%	± 0.10
Organisms, ≥ 50 µm	inds./m ³	1	NA	≤ CV 15%	≥ 95% ^a
Organisms, ≥ 10 - 50 µm	inds./mL	1	NA	≥ 75% average PSC	≥ 95% ^a
Heterotrophic bacteria	cell/mL	1	30 ~ 300	≤ CV 5%	≥ 95% ^a
Coliform	CFU/100 mL	1	20 ~ 80	≤ CV 5%	≥ 95% ^a
<i>Escherichia coli</i>	CFU/100 mL	1	20 ~ 80	≤ CV 5%	≥ 95% ^a
Intestinal Enterococci	CFU/100 mL	1	20 ~ 60	≤ CV 5%	≥ 95% ^a
Toxicogenic <i>Vibrio cholerae</i> (serotype O1 and O139)	CFU/100 mL	1	NA	≤ CV 5%	≥ 95% ^a

^a In general, accuracy should be within the range of 70 – 130 percent recovery of exogenous analyte.

Water quality meters (multi-probe) will be daily pre-calibrated prior to the commencement of field activities in accordance with manufacturer's instruction. Suspect calibration information will be highlighted in the field data notebook upon discovery of the information. Data collected during the period of suspect information will be footnoted as being questionable.

Table 10. Quality assurance sample types, frequency of use, and types of data generated for KOMERI

Parameters	QA sample type or measurement procedure	Frequency of use	Data generated for calibration and redundancy
Chemical water quality MS5 sonde (Hydrolab)			
Salinity	Certified standard conductivity solution (~ 50 µS/cm)	Each test cycle	Difference between probe value and standard level
Dissolved oxygen	Water-saturated air calibration	Each test cycle	Difference between probe value and saturation level
Water Temperature	QC check with standard thermometer	Each test cycle	Difference between probe and thermometer

pH	QC check with standard buffers	Each test cycle	Difference between probe and standards
Dissolved organic carbon	QC check with standard (potassium hydrogen phthalate) / Proficiency testing	Each test cycle	Difference between sample and duplicate
Total organic carbon	QC check with standard (potassium hydrogen phthalate) / Proficiency testing	Each test cycle	Difference between sample and duplicate
Total suspended solid	QC check with duplicate	Each test period	Difference between sample and duplicate
Chemical water quality Turbidity meter (HACH)			
Turbidity	Certified standard turbidity solution (0, 10, 100, 1000 NTU)	Each test period	Difference between sample and duplicate
Biological water quality			
Organisms $\geq 50 \mu\text{m}$	QC check duplicate and other identification data	Each test period / species assemblage	Comparison of 5 samples, standard deviation
Organisms $\geq 10 - 50 \mu\text{m}$	QC check duplicate and other identification data	Each test period / species assemblage	Comparison of 5 samples, standard deviation
Bacteriological water quality			
Heterotrophic bacteria	QC check duplicate	Each test period and/or every sample	Comparison of 5 samples, standard deviation
Coliform	QC check duplicate	Each test period and/or every sample	Comparison of 5 samples, standard deviation
<i>Escherichia coli</i>	QC check duplicate	Each test period and/or every sample	Comparison of 5 samples, standard deviation
Intestinal Enterococci	QC check duplicate	Each test period and/or every sample	Comparison of 5 samples, standard deviation
Toxicogenic <i>Vibrio Cholerae</i> (O1, O139)	QC check duplicate	Each test period and/or every sample	Comparison of 5 samples, standard deviation

3.1.2 Chemical analysis

Quality assurance objectives & Procedure for the KTR Laboratory are listed in Figure 12 and Table 11. Individual research/study/test projects may develop QA objectives that will replace the objectives listed here. It is object to validate results by writing SOPs to assure the reliability of the test results. QA/QC aim at reporting all analytical procedures from sampling to results and method validation parameter (MDL, Precision, Accuracy etc.) during analysis procedure are corresponding linearity and range, accuracy and precision, and the detection limit and quantitation limit. Given data generally followed specified test methods.

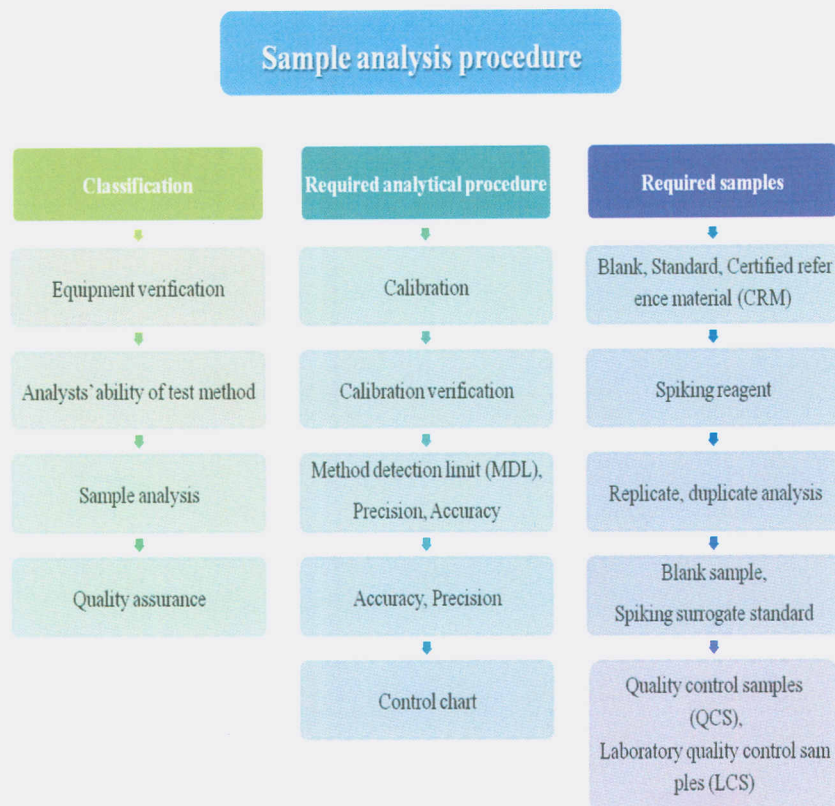


Figure 12. Procedure for quality assurance of analysis result

Table 11. Quality assurance objectives of KTR

	Analysis item	unit	Method Detection Limit ^a	Conc. Range ^b	Accuracy Objective ^c	Precision Objective ^d
Precursor	TRO	mg/L	0.03	1~10	80~120%	<20%
	FRO	mg/L	0.03	1~10	80~120%	<20%
	Ozone(O ₃)	mg/L	0.13	1~20	NA ^c	NA
	ClO ₂	mg/L	0.02	1~10	NA	NA
	Sulfide(S ²⁻)	mg/L	0.02	0.02~0.2	NA	NA
	Chloride(Cl ⁻)	mg/L	0.02	0.5~10	80~120%	<20%
	Bromide(Br ⁻)	mg/L	0.06	0.5~10	80~120%	<20%
	Chlorate(ClO ₃)	mg/L	0.04	0.5~10	80~120%	<20%
	AOX	mg/L	0.01	0~1.0	NA	NA
	DOC	mg/L	0.04	1~20	80~120%	<20%
	POC	mg/L	0.04	1~20	80~120%	<20%
Inorganic by-products	Bromate (BrO ₃)	μg/L	0.34	5~100	80~120%	<20%
Halogenated VOCs	1,1-Dichloroethene	μg/L	0.05	0.5~200	75~125%	<25%
	trans-1,2-Dichloroethene	μg/L	0.06	0.5~200	75~125%	<25%
	1,1-Dichloroethane	μg/L	0.05	0.5~200	75~125%	<25%
	cis-1,2-Dichloroethene	μg/L	0.08	0.5~200	75~125%	<25%
	Bromochloromethane	μg/L	0.04	0.5~200	75~125%	<25%
	Trichloromethane	μg/L	0.03	0.5~200	75~125%	<25%

	1,1,1-Trichloroethane	µg/L	0.04	0.5~200	75~125%	<25%
	Dibromomethane	µg/L	0.12	0.5~200	75~125%	<25%
	1,2-Dichloropropane	µg/L	0.04	0.5~200	75~125%	<25%
	1,1,2-Trichloroethane	µg/L	0.10	0.5~200	75~125%	<25%
	Dibromochloromethane	µg/L	0.05	0.5~200	75~125%	<25%
	Tetrachloroethene	µg/L	0.02	0.5~200	75~125%	<25%
	1,1,1,2-Tetrachloroethane	µg/L	0.05	0.5~200	75~125%	<25%
	Chlorobenzene	µg/L	0.04	0.5~200	75~125%	<25%
	Tribromomethane	µg/L	0.08	0.5~200	75~125%	<25%
	1,1,2,2-Tetrachloroethane	µg/L	0.05	0.5~200	75~125%	<25%
	1,2,3-Trichloropropane	µg/L	0.07	0.5~200	75~125%	<25%
	Bromobenzene	µg/L	0.03	0.5~200	75~125%	<25%
	2-Chlorotoluene	µg/L	0.04	0.5~200	75~125%	<25%
	4-Chlorotoluene	µg/L	0.04	0.5~200	75~125%	<25%
	1,2-Dibromo-3-chloropropane	µg/L	0.13	0.5~200	75~125%	<25%
	1,2,4-Trichlorobenzene	µg/L	0.03	0.5~200	75~125%	<25%
	1,2,3-Trichlorobenzene	µg/L	0.04	0.5~200	75~125%	<25%
	1,3,5-Tribromobenzene	µg/L	0.05	0.5~200	75~125%	<25%
	1,2,4-Tribromobenzene	µg/L	0.06	0.5~200	75~125%	<25%
HANs	Monobromoacetonitrile	µg/L	0.02	0.33~6.67	80~120%	<20%
	Bromochloroacetonitrile	µg/L	0.03	0.33~6.67	80~120%	<20%
	Dibromoacetonitrile	µg/L	0.04	0.33~6.67	80~120%	<20%
	Trichloroacetonitrile	µg/L	0.03	0.33~6.67	80~120%	<20%
	Dichloroacetonitrile	µg/L	0.03	0.33~6.67	80~120%	<20%
	Monochloroacetonitrile	µg/L	0.03	0.33~6.67	80~120%	<20%
Miscellaneous DBPs	Chloral hydrate	µg/L	0.03	0.33~6.67	80~120%	<20%
	Chloropicrin	µg/L	0.08	0.33~6.67	80~120%	<20%
HAAs	Monochloroacetic acid	µg/L	0.14	2~200	70~130%	<25%
	Monobromoacetic acid	µg/L	0.08	2~200	70~130%	<25%
	Dichloroacetic acid	µg/L	0.08	2~200	70~130%	<25%
	Dalapon	µg/L	0.08	2~200	70~130%	<25%
	Trichloroacetic acid	µg/L	0.03	2~200	70~130%	<25%
	Bromochloroacetic acid	µg/L	0.05	2~200	70~130%	<25%
	Dibromoacetic acid	µg/L	0.11	2~200	70~130%	<25%
	Bromodichloroacetic acid	µg/L	0.21	2~200	70~130%	<25%
	Tribromoacetic acid	µg/L	0.43	2~200	70~130%	<25%
Halogenated phenols	2-Chlorophenol	µg/L	0.04	0.1~1.0	80~120%	<20%
	3-Chlorophenol	µg/L	0.03	0.1~1.0	80~120%	<20%
	4-Chlorophenol	µg/L	0.03	0.1~1.0	80~120%	<20%
	2,6-Dichlorophenol	µg/L	0.03	0.1~1.0	80~120%	<20%
	2,5-Dichlorophenol	µg/L	0.01	0.1~1.0	80~120%	<20%
	2,4-Dichlorophenol	µg/L	0.03	0.1~1.0	80~120%	<20%
	3,5-Dichlorophenol	µg/L	0.03	0.1~1.0	80~120%	<20%
	2,3-Dichlorophenol	µg/L	0.02	0.1~1.0	80~120%	<20%
	3,4-Dichlorophenol	µg/L	0.03	0.1~1.0	80~120%	<20%
	2,4,6-Trichlorophenol	µg/L	0.04	0.1~1.0	80~120%	<20%
	2,3,6-Trichlorophenol	µg/L	0.03	0.1~1.0	80~120%	<20%

	2,4,5-Trichlorophenol	µg/L	0.06	0.1~1.0	80~120%	<20%
	2,3,5-Trichlorophenol	µg/L	0.06	0.1~1.0	80~120%	<20%
	3,4,5-Trichlorophenol	µg/L	0.05	0.1~1.0	80~120%	<20%
	2,3,4-Trichlorophenol	µg/L	0.06	0.1~1.0	80~120%	<20%
	2,3,5,6-Tetrachlorophenol	µg/L	0.05	0.1~1.0	80~120%	<20%
	2,3,4,6-Tetrachlorophenol	µg/L	0.04	0.1~1.0	80~120%	<20%
	2,3,4,5-Tetrachlorophenol	µg/L	0.04	0.1~1.0	80~120%	<20%
	Pentachlorophenol	µg/L	0.03	0.1~1.0	80~120%	<20%
	2,6-Dibromophenol	µg/L	0.02	0.1~1.0	80~120%	<20%
	2,4-Dibromophenol	µg/L	0.05	0.1~1.0	80~120%	<20%
	2,4,6-Tribromophenol	g/cm ³	0.03	0.1~1.0	80~120%	<20%
Other	Density	g/cm ³	0.0001	NA	NA	NA

^a The method detection limit is determined as a one-sided 99% confidence interval from repeated measurements of a lowest-level standard across several calibration curves, and as a data from manufacturer or Detection limit was calculated value that $S \times 3.14$

^b Concentration Range =

- Initial calibration should be conducted with at least five different concentration of target analytical standard (eg. 1, 5, 10, 20, 40)

- If response factors or correlation factors are used, relative standard deviation (RSD) of each analyte should be $\leq 20\%$

- If the linear regression method is used, correlation coefficient should be > 0.99

^c Accuracy is estimated as the difference between the measured and target values of performance evaluation samples at the lower concentration range and as the difference at the higher concentration range.

Accuracy (%) = $x/x_i \times 100$; x_i : Certified or theoretical value, x : Mean measured value

^d Precision is estimated as the percent relative standard deviation of repeated measurement (7 times) at the low constant concentration.

Precision (%) = $RSD = S/x \times 100$; x : Mean measured value, S : standard deviation

^e NA: Not available.

Method validation parameters that are written in the table are quoted from the reference and they might slightly vary depending on the environmental conditions (equipment, pretreatment conditions, and sample characteristics).

If necessary, each test day, water quality meters will be pre-calibrated prior to the commencement of field activities in accordance with the manufacturer's instruction.

3.1.3 WET testing

Quality assurance objectives and procedure for the MEI Laboratory show on Table 12 and Figure 13. Individual research/study/test projects may develop QA objectives that will replace the objectives listed here. It is objected to validate results by writing SOPs to assure the reliability of the test results. QA/QC objectives to report all WET testing procedures from study plan to final report.

Table 12. Quality assurance objectives of MEI

Division (Guideline)	Test organism	Reference substance	Precision object	Criteria of Validation
Algae (OECD 201)	Diatom (<i>Skeletonema costatum</i>)	Potassium dichromate	72h-EC50: 2.5 ± 1.1 mg/L ^a	<ul style="list-style-type: none"> - Specific growth rate in the control: $\geq 0.92 \text{ day}^{-1}$ - Coefficient variation of average growth in replicate in the control: $\leq 7\%$ - Mean coefficient variation for section-by-section specific growth rates in the control: $\leq 35\%$ - pH change in the control: < 1.5
Invertebrate (ASTM E-1440-91)	Rotifer (<i>Brachionus plicatilis</i>)	Potassium dichromate	24h-LC50: 384 ± 175.4 mg/L ^b	<ul style="list-style-type: none"> - Survival of all organisms in the control: $\geq 90\%$ - All test chambers: identical - Dilution water: including in the test - Measurement: Temp., pH, Sal. (instead of hardness) and D.O.
Fish (OECD 203)	Oliver flounder (<i>Paralichthys olivaceus</i>)	N.A. ^c	N.A. ^c	<ul style="list-style-type: none"> - Survival of all organisms in the control: $\geq 90\%$ (not exceed 10% of mortality) - D.O. concentration: $> 60\%$ air saturation value throughout the test - Temperature: constant within a range of 2°C

^a Precision object of algae is applied by inter-laboratory test results in ISO10253 (2006).

^b Precision object of rotifer is applied by test results in ECOTOX database of US EPA

^c Not Available

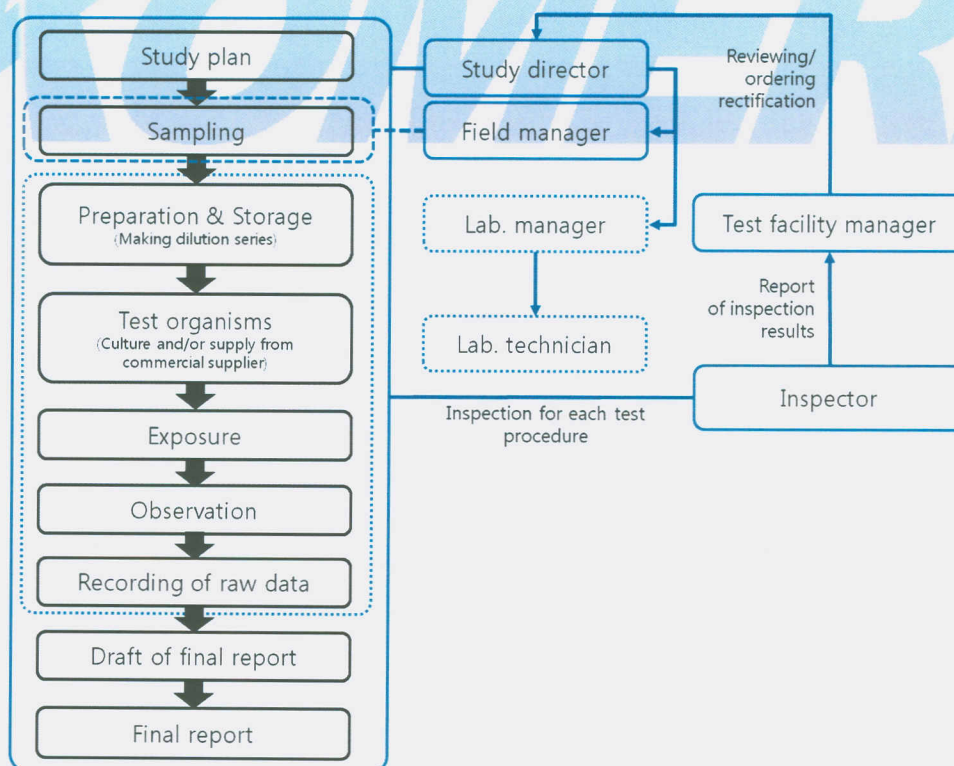


Figure 13. Flow chart for quality control and assurance of WET testing (black rounding box: each test step; blue rounding box: responsible persons)

3.2 Quality control procedures

Three types of internal quality control samples, blank sample and/or duplicates sample are routinely used at the laboratories.

A field duplicate is a sample which is collected immediately after regular sampling at the same location. This type of co-located field duplicate is estimated precision of the whole sampling process including inherent variability at the field site.

The quality control samples used are:

- A synthetic water quality control check sample is analyzed at least twice in each run for pH, salinity, water temperature, oxidation-reduction potential, dissolved oxygen and turbidity samples.
- In case of plankton, two sets of the dyed and undyed samples are prepared.
- For the analysis of bacteria, the routine analysis of positive and negative controls, filter sterility checks, method blanks and media sterility checks are required.

KOMERI

4. ASSESSEMENT/OVERSIGHT

4.1 Assessments and corrective actions

The laboratory as part of their QA program will conduct laboratory performance and system audits. System audits will be done on an annual basis at a minimum and will include an examination of laboratory documentation on sample receipt/log-in/storage/chain-of-custody, procedures, sample preparation and analysis, instrument operating records, etc.

Field audits will include examination of field sampling records/screening results/instrument operating records, sample collection, handling, and packaging in compliance with the established procedures, maintenance of QA procedures, chain-of-custody, etc. Follow-up audits will be conducted to correct deficiencies, and to verify that QA procedures are maintained through the investigation. The audits will involve reviews of field measurement records, instrumentation calibration records, and sample documentation.

The corrective action is the process of identifying, recommending, approving, and implementing measures to counteract unacceptable procedures or out-of-limit QC performance that can affect data quality. The corrective actions can occur during field activities, laboratory analysis, data validation, and data assessment. The corrective actions should only be implemented after approval by the Project Director or his designee.

For non-compliance problems, a formal corrective action program will be determined and implemented at the time that the problem is identified. The person who identifies the problem is responsible for notifying the Project Director.

4.2 Reports to management

The results of assessments conducted under this QAPP will be reported to the management during the weekly (after 1 period test) Project Progress Meeting and remedial action taken in accordance with the procedures.

REFERENCES

- Anja S, T. Cheryl, S. James, S. Kristin. 2005. Application of Alamar blue/5-carboxyfluorescein diacetate acetoxymethyl ester as a noninvasive cell viability assay in primary hepatocytes from rainbow trout. *Analytical Biochemistry*. (344) 76-85.
- Fleming, J.M., Coughlan, J. 1978. Preservation of vitally stained zooplankton for live/dead sorting. *Estuaries* (1) 135-137.
- ISO 8245. 1999. Water quality-Guidelines for the determination of total organic carbon (TOC) and dissolved organic carbon (DOC). 2nd Ed.
- Janssen C.R., G. Persoone and T. W. Snell. 1994. Cyst-based toxicity tests. VIII. Short-chronic toxicity tests with the freshwater rotifer *Brachionus calyciflorus*. *Aquatic Toxicology*, 28, 243-258.
- Standard Methods. 2005. In: A.D Eaton, L.S Clesceri, E.W Rice, A.E Greenberg (eds), *Standard Methods for the Examination of Water and Wastewater*. Baltimore, Maryland. APHA, AWWA and WEF. pp
- US EPA. 2000. Coastal 2000, Northeast Component, Field Operation Manual. Charles J. S (ed.).
- US EPA 600/R-10/146. 2010. Protocol for the Verification of Ballast Water Treatment Technologies. Section 5.4.6.4. p45.

Agreement for change of the test schedule of AquaStar™ project

This document is made for information that land-based test schedule of AquaStar™ project will be changed under the control of Korea Marine Equipment Research Institute (KOMERI) and agreement on change of land-based test schedule of AquaStar™ project.

AQUA Eng. Co., Ltd. and KOMERI agree as follows:

- A additional land-based test will be performed for making up for recommendations of Administration to submit Final Approval. Test date is as below;

Date of ballasting : 6th, October, 2010



Date of de-ballasting : 11th, October, 2010

- In like manner to regular land-based test, the additional test also must be under the control of KOMERI.
- The whole situation (operation, maintenance and so on) of AquaStar™ BWMS must be reported KOMERI in detail and come into action with KOMERI's agreement.
- Concomitants of land-based test for Final Approval must be performed in the presence of KOMERI. And data of performances will be accompanied by a COC format at each time and then binding for keeping in accordance with KOMERI QAPP.
- If AQUA Eng. Co., Ltd. break this agreement, AQUA Eng. Co., Ltd. put up with any disadvantages.

In witness whereof the parties hereto have caused this agreement to be executed the day and year in accordance with their respective the laws.


1 October 2010


System Developer
AQUA Eng. Co., Ltd.
938-8, Dalsan-ri, Jeonggan-myeon, Gijang-gun, Busan,
Republic of Korea
Tel. 82-51-728-1270~2
Fax. 82-51-728-1273


1 October 2010


Primary System Tester
(Type Approval Test Organization)
Korea Marine Equipment Research Institute
1125-22 Dongsam-dong, Youngdo-gu, Busan, Republic
of Korea
Tel. 82-51-400-5001
Fax. 82-51-400-5091

Agreement for change of the test schedule of AquaStar™ project

This document is made for information that land-based test schedule of AquaStar™ project will be changed under the control of Korea Marine Equipment Research Institute (KOMERI) and agreement on change of land-based test schedule of AquaStar™ project.

AQUA Eng. Co., Ltd. and KOMERI agree as follows:

- A additional land-based test will be performed for making up for recommendations of GESAMP-BWWG to re-submit Final Approval. Test date is as below;

Date of ballasting : 17th, June, 2011

Date of de-ballasting : 22nd, June, 2011

- In like manner to regular land-based test, the additional test also must be under the control of KOMERI.
- The whole situation (operation, maintenance and so on) of AquaStar™ BWMS must be reported KOMERI in detail and come into action with KOMERI's agreement.
- Concomitants of land-based test for Final Approval must be performed in the presence of KOMERI. And data of performances will be accompanied by a COC format at each time and then binding for keeping in accordance with KOMERI QAPP.
- If AQUA Eng. Co., Ltd. break this agreement, AQUA Eng. Co., Ltd. put up with any disadvantages.

In witness whereof the parties hereto have caused this agreement to be executed the day and year in accordance with their respective the laws.


3 June 2011



System Developer
AQUA Eng. Co., Ltd.
938-8, Dalsan-ri, Jeonggan-myeon, Gijang-gun, Busan,
Republic of Korea
Tel. 82-51-728-1270~2
Fax. 82-51-728-1273


3 June 2011



Primary System Tester
(Type Approval Test Organization)
Korea Marine Equipment Research Institute
1125-22 Dongsam-dong, Youngdo-gu, Busan, Republic
of Korea
Tel. 82-51-400-5001
Fax. 82-51-400-5091

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 <i>Serial No.</i>	KOMERI-10TA0027	장 비 명 <i>Equipment name</i>	탁도계 Portable Turbidimeter	설치장소 <i>Installation Location</i>	수중생물학시험실 Microbiology laboratory	작 성 <i>Written by</i>	확 인 <i>Approved by</i>
점검일자 <i>Date</i>	2010. 06. 29	점검주기 <i>Inspection period</i>	The day before test	관 리 자 <i>Manager</i>	정 부 김 영 수 양 준 혁	06.29.29	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>							
1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다. 1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).		Turbidity (NTU)							
		< 0.1		20		100		800	
		Before	After	Before	After	Before	After	Before	After
		0.17	0.07	22.0	19.0	109	99.0	179	806
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기								

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-09TA0006	장 비 명 Equipment name	수질다항목측정기 Water Quality Multiprobes	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory	작 성 Written by	확 인 Approved by
점검일자 Date	2010. 06. 29	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁	06f	2010

점검요령 <i>procedure</i>		점검결과 <i>Results</i>																															
<div>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다. <i>1. Calibrate with a pH standard solution (pH 4, 7, 10).</i></div> <div>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다. <i>2. Calibrate with a ORP standard solution (228 mV).</i></div> <div>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다. <i>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</i></div> <div>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다. <i>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂SO₃ solution.</i></div>		<table><tr><th colspan="6">pH</th></tr><tr><th colspan="2">4</th><th colspan="2">7</th><th colspan="2">10</th></tr><tr><td>Before</td><td>After</td><td>Before</td><td>After</td><td>Before</td><td>After</td></tr><tr><td>3.17</td><td>4.00</td><td>6.92</td><td>7.00</td><td>9.81</td><td>10.0</td></tr></table>								pH						4		7		10		Before	After	Before	After	Before	After	3.17	4.00	6.92	7.00	9.81	10.0
		pH																															
		4		7		10																											
		Before	After	Before	After	Before	After																										
		3.17	4.00	6.92	7.00	9.81	10.0																										
		<table><tr><th colspan="2">OPR (mV)</th><th colspan="2">Conductivity (mS/cm)</th><th colspan="2">Salinity (psu)</th><th colspan="2">DO (mg/L)</th></tr><tr><td>Before</td><td>After</td><td>Before</td><td>After</td><td>Before</td><td>After</td><td>Before</td><td>After</td></tr><tr><td>221</td><td>228</td><td>57.69</td><td>58.64</td><td>0.17</td><td>0.00</td><td>0.10</td><td>0.00</td></tr></table>								OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)		Before	After	Before	After	Before	After	Before	After	221	228	57.69	58.64	0.17	0.00	0.10	0.00
		OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)																									
		Before	After	Before	After	Before	After	Before	After																								
		221	228	57.69	58.64	0.17	0.00	0.10	0.00																								
특기사항 <i>Remarks</i>		○ : 양호, △ : 수리 요망, X : 폐기																															

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Equipment check records

관리번호 Serial No.	KOMERI-10TA0027	장 비 명 Equipment name	탁도계 Portable Turbidimeter	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory	작 성 Written by	확 인 Approved by
점검일자 Date	2010.07.02	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁	06.5.02	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>							
1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다. 1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).		Turbidity (NTU)							
		< 0.1		20		100		800	
		Before	After	Before	After	Before	After	Before	After
		0.21	0.07	14.0	21.0	97.0	100	769	807
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기								

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Equipment check records

관리번호 Serial No.	KOMERI-09TA0006	장 비 명 Equipment name	수질다항목측정기 Water Quality Multiprobes	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory	작 성 Written by	확 인 Approved by
점검일자 Date	2010.07.02	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁	06.5.00	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>									
<div>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다. <i>1. Calibrate with a pH standard solution (pH 4, 7, 10).</i></div> <div>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다. <i>2. Calibrate with a ORP standard solution (228 mV).</i></div> <div>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다. <i>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</i></div> <div>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다. <i>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂SO₃ solution.</i></div>		pH									
		4		7		10					
		Before	After	Before	After	Before	After				
		7.91	4.00	6.24	7.00	9.17	10.0				
		OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)			
		Before	After	Before	After	Before	After	Before	After		
		227	228	57.91	58.64	0.17	0.00	0.15	0.00		
		특기사항 <i>Remarks</i>		○ : 양호, △ : 수리 요망, X : 폐기							

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관리번호 <i>Serial No.</i>	KOMERI-10TA0027	장 비 명 <i>Equipment name</i>	탁도계 Portable Turbidimeter	설치장소 <i>Installation Location</i>	수중생물학시험실 Microbiology laboratory	작 성 <i>Written by</i>	확 인 <i>Approved by</i>
점검일자 <i>Date</i>	2010. 07. 06	점검주기 <i>Inspection period</i>	The day before test	관 리 자 <i>Manager</i>	정 김 영 수 부 양 준 혁	0650	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>							
1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다. 1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).		Turbidity (NTU)							
		< 0.1		20		100		800	
		Before	After	Before	After	Before	After	Before	After
		0.11	0.09	19.0	21.0	98.0	100	191	201
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기								

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 <i>Serial No.</i>	KOMERI-09TA0006	장 비 명 <i>Equipment name</i>	수질다항목측정기 Water Quality Multiprobes	설치장소 <i>Installation Location</i>	수중생물학시험실 Microbiology laboratory
점검일자 <i>Date</i>	2010. 07. 06	점검주기 <i>Inspection period</i>	The day before test	관 리 자 <i>Manager</i>	정 부 김 영 수 양 준 혁

작 성 <i>Written by</i>	확 인 <i>Approved by</i>
Ob. 수현	김영수

점검요령 procedure	점검결과 Results																																																
<p>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다.</p> <p>1. Calibrate with a pH standard solution (pH 4, 7, 10).</p> <p>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다.</p> <p>2. Calibrate with a ORP standard solution (228 mV).</p> <p>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다.</p> <p>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</p> <p>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다.</p> <p>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂SO₃ solution.</p>	<table><tr><th colspan="6">pH</th></tr><tr><th colspan="2">4</th><th colspan="2">7</th><th colspan="2">10</th></tr><tr><th>Before</th><th>After</th><th>Before</th><th>After</th><th>Before</th><th>After</th></tr><tr><td>7.98</td><td>4.00</td><td>6.87</td><td>7.00</td><td>9.91</td><td>10.0</td></tr></table> <table><tr><th colspan="2">OPR (mV)</th><th colspan="2">Conductivity (mS/cm)</th><th colspan="2">Salinity (psu)</th><th colspan="2">DO (mg/L)</th></tr><tr><th>Before</th><th>After</th><th>Before</th><th>After</th><th>Before</th><th>After</th><th>Before</th><th>After</th></tr><tr><td>210</td><td>228</td><td>58.61</td><td>58.64</td><td>0.07</td><td>0.00</td><td>0.11</td><td>0.00</td></tr></table>	pH						4		7		10		Before	After	Before	After	Before	After	7.98	4.00	6.87	7.00	9.91	10.0	OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)		Before	After	Before	After	Before	After	Before	After	210	228	58.61	58.64	0.07	0.00	0.11	0.00
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Before	After	Before	After	Before	After																																												
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210	228	58.61	58.64	0.07	0.00	0.11	0.00																																										
특기사항 Remarks	○ : 양호, △ : 수리 요망, X : 폐기																																																

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 <i>Serial No.</i>	KOMERI-10TA0027	장 비 명 <i>Equipment name</i>	탁도계 Portable Turbidimeter	설치장소 <i>Installation Location</i>	수중생물학시험실 Microbiology laboratory		작 성 <i>Written by</i>	확 인 <i>Approved by</i>
점검일자 <i>Date</i>	2010. 07. 09	점검주기 <i>Inspection period</i>	The day before test	관 리 자 <i>Manager</i>	정 부	김 영 수 양 준 혁	06-5-02	김영수

점검요령 <i>procedure</i>	점검결과 <i>Results</i>																																
<p>1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다.</p> <p>1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).</p>	<table border="1"> <thead> <tr> <th colspan="8">Turbidity (NTU)</th> </tr> <tr> <th colspan="2">< 0.1</th> <th colspan="2">20</th> <th colspan="2">100</th> <th colspan="2">800</th> </tr> <tr> <th>Before</th> <th>After</th> <th>Before</th> <th>After</th> <th>Before</th> <th>After</th> <th>Before</th> <th>After</th> </tr> </thead> <tbody> <tr> <td>0.13</td> <td>0.07</td> <td>17.0</td> <td>21.0</td> <td>96.0</td> <td>102</td> <td>779</td> <td>810</td> </tr> </tbody> </table>	Turbidity (NTU)								< 0.1		20		100		800		Before	After	Before	After	Before	After	Before	After	0.13	0.07	17.0	21.0	96.0	102	779	810
Turbidity (NTU)																																	
< 0.1		20		100		800																											
Before	After	Before	After	Before	After	Before	After																										
0.13	0.07	17.0	21.0	96.0	102	779	810																										
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기																																

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-09TA0006	장 비 명 Equipment name	수질다항목측정기 Water Quality Multiprobes	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory	작 성 Written by	확 인 Approved by
점검일자 Date	2010. 07. 09	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁	06.5.02	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>							
<div>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다. <i>1. Calibrate with a pH standard solution (pH 4, 7, 10).</i></div> <div>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다. <i>2. Calibrate with a ORP standard solution (228 mV).</i></div> <div>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다. <i>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</i></div> <div>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다. <i>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂SO₃ solution.</i></div>		pH							
		4		7		10			
		Before	After	Before	After	Before	After		
		7.96	4.00	6.79	7.00	9.91	10.0		
		OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)	
		Before	After	Before	After	Before	After	Before	After
		218	228	58.17	58.64	0.31	0.00	0.02	0.00
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기								

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-10TA0027	장 비 명 Equipment name	탁도계 Portable Turbidimeter	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory		작 성 Written by	확 인 Approved by
점검일자 Date	2010. 07. 13	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부	김 영 수 양 준 혁	06.5.02	김영수

점검요령 procedure	점검결과 Results																																
<p>1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다.</p> <p>1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).</p>	<table border="1"> <thead> <tr> <th colspan="8">Turbidity (NTU)</th> </tr> <tr> <th colspan="2">< 0.1</th> <th colspan="2">20</th> <th colspan="2">100</th> <th colspan="2">800</th> </tr> <tr> <th>Before</th> <th>After</th> <th>Before</th> <th>After</th> <th>Before</th> <th>After</th> <th>Before</th> <th>After</th> </tr> </thead> <tbody> <tr> <td>0.12</td> <td>0.02</td> <td>18.0</td> <td>20.0</td> <td>97.0</td> <td>103</td> <td>789</td> <td>792</td> </tr> </tbody> </table>	Turbidity (NTU)								< 0.1		20		100		800		Before	After	Before	After	Before	After	Before	After	0.12	0.02	18.0	20.0	97.0	103	789	792
Turbidity (NTU)																																	
< 0.1		20		100		800																											
Before	After	Before	After	Before	After	Before	After																										
0.12	0.02	18.0	20.0	97.0	103	789	792																										
특기사항 Remarks	○ : 양호, △ : 수리 요망, X : 폐기																																

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-09TA0006	장 비 명 Equipment name	수질다항목측정기 Water Quality Multiprobes	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory
점검일자 Date	2010. 07. 13	점검주기 Inspection period	The day before test	관 리 자 Manager	정 김 영 수 부 양 준 혁

작 성 Written by	확 인 Approved by
06.5.00	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>							
<div>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다. <i>1. Calibrate with a pH standard solution (pH 4, 7, 10).</i></div> <div>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다. <i>2. Calibrate with a ORP standard solution (228 mV).</i></div> <div>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다. <i>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</i></div> <div>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다. <i>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂SO₃ solution.</i></div>		pH							
		4		7		10			
		Before	After	Before	After	Before	After		
		7.96	4.00	6.67	7.00	9.87	10.0		
		OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)	
		Before	After	Before	After	Before	After	Before	After
		221	228	57.97	58.64	0.26	0.00	0.27	0.00
		특기사항 <i>Remarks</i>		○ : 양호, △ : 수리 요망, X : 폐기					

장 비 중 간 점 검 기 록 서

Equipment check records

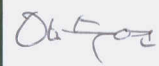

관리번호 <i>Serial No.</i>	KOMERI-09TA0006	장 비 명 <i>Equipment name</i>	수질다항목측정기 Water Quality Multiprobes	설치장소 <i>Installation Location</i>	수중생물학시험실 Microbiology laboratory
점검일자 <i>Date</i>	2010. 07. 16	점검주기 <i>Inspection period</i>	The day before test	관 리 자 <i>Manager</i>	정 부 김 영 수 양 준 혁

작 성 <i>Written by</i>	확 인 <i>Approved by</i>
Obf	김영수

점검요령 <i>procedure</i>	점검결과 <i>Results</i>							
<div>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다.</div> <div>1. Calibrate with a pH standard solution (pH 4, 7, 10).</div> <div>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다.</div> <div>2. Calibrate with a ORP standard solution (228 mV).</div> <div>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다.</div> <div>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</div> <div>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다.</div> <div>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂SO₃ solution.</div>	pH							
	4		7		10			
	Before	After	Before	After	Before	After	Before	After
	4.17	4.00	7.26	7.00	10.10		10.00	
OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)		
Before	After	Before	After	Before	After	Before	After	
227	228	58.61	58.64	0.07	0.00	0.07	0.00	
특기사항 <i>Remarks</i>		○ : 양호, △ : 수리 요망, X : 폐기						

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-10TA0027	장 비 명 Equipment name	탁도계 Portable Turbidimeter	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory		작 성 Written by	확 인 Approved by
점검일자 Date	2010. 07. 16	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부	김 영 수 양 준 혁		

점검요령 procedure		점검결과 Results							
<p>1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다.</p> <p>1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).</p>		Turbidity (NTU)							
		< 0.1		20		100		800	
		Before	After	Before	After	Before	After	Before	After
		0.10	0.08	19.0	19.0	99.0	100	794	798
특기사항 Remarks	○ : 양호, △ : 수리 요망, X : 폐기								

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-10TA0027	장 비 명 Equipment name	탁도계 Portable Turbidimeter	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory		작 성 Written by	확 인 Approved by
점검일자 Date	2010. 07. 20	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부	김 영 수 양 준 혁	06.5.02	김 영 수

점검요령 procedure		점검결과 Results							
<p>1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다.</p> <p>1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).</p>		Turbidity (NTU)							
		< 0.1		20		100		800	
		Before	After	Before	After	Before	After	Before	After
		0.17	0.06	22.0	20.0	112	99.0	833	801
특기사항 Remarks	○ : 양호, △ : 수리 요망, X : 폐기								

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-09TA0006	장 비 명 Equipment name	수질다항목측정기 Water Quality Multiprobes	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory
점검일자 Date	2010. 07. 20	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁

작 성 Written by	확 인 Approved by
06500	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>									
<p>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다.</p> <p>1. Calibrate with a pH standard solution (pH 4, 7, 10).</p> <p>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다.</p> <p>2. Calibrate with a ORP standard solution (228 mV).</p> <p>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다.</p> <p>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</p> <p>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다.</p> <p>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂SO₃ solution.</p>		pH									
		4		7		10					
		Before	After	Before	After	Before	After				
		7.99	4.00	6.94	7.00	9.98	10.00				
		OPR (mV)				Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)	
		Before	After	Before	After	Before	After	Before	After		
		224	228	57.94	58.64	0.10	0.00	0.08	0.00		
		특기사항 <i>Remarks</i>		○ : 양호, △ : 수리 요망, X : 폐기							

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 <i>Serial No.</i>	KOMERI-10TA0027	장 비 명 <i>Equipment name</i>	탁도계 Portable Turbidimeter	설치장소 <i>Installation Location</i>	수중생물학시험실 <i>Microbiology laboratory</i>		작 성 <i>Written by</i>	확 인 <i>Approved by</i>
점검일자 <i>Date</i>	2010.07.27	점검주기 <i>Inspection period</i>	The day before test	관 리 자 <i>Manager</i>	정 부	김 영 수 양 준 혁	06.5.00	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>								
1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다. 1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).		Turbidity (NTU)								
		< 0.1		20		100		800		
		Before	After	Before	After	Before	After	Before	After	
		0.17	0.07	22.0	19.0	107	101	816	807	
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기									

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 <i>Serial No.</i>	KOMERI-09TA0006	장 비 명 <i>Equipment name</i>	수질다항목측정기 Water Quality Multiprobes	설치장소 <i>Installation Location</i>	수중생물학시험실 Microbiology laboratory
점검일자 <i>Date</i>	2010.07.27	점검주기 <i>Inspection period</i>	The day before test	관 리 자 <i>Manager</i>	정 부 김 영 수 양 준 혁

작 성 <i>Written by</i>	확 인 <i>Approved by</i>
06-수연	김영수

점검요령 <i>procedure</i>	점검결과 <i>Results</i>																															
<p>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다.</p> <p><i>1. Calibrate with a pH standard solution (pH 4, 7, 10).</i></p> <p>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다.</p> <p><i>2. Calibrate with a ORP standard solution (228 mV).</i></p> <p>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다.</p> <p><i>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</i></p> <p>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다.</p> <p><i>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂SO₃ solution.</i></p>	<table><tr><th colspan="6">pH</th></tr><tr><td colspan="2">4</td><td colspan="2">7</td><td colspan="2">10</td></tr><tr><td>Before</td><td>After</td><td>Before</td><td>After</td><td>Before</td><td>After</td></tr><tr><td>3.96</td><td>4.00</td><td>6.91</td><td>7.00</td><td>9.91</td><td>10.0</td></tr></table>								pH						4		7		10		Before	After	Before	After	Before	After	3.96	4.00	6.91	7.00	9.91	10.0
	pH																															
	4		7		10																											
	Before	After	Before	After	Before	After																										
	3.96	4.00	6.91	7.00	9.91	10.0																										
<table><tr><th colspan="2">OPR (mV)</th><th colspan="2">Conductivity (mS/cm)</th><th colspan="2">Salinity (psu)</th><th colspan="2">DO (mg/L)</th></tr><tr><td>Before</td><td>After</td><td>Before</td><td>After</td><td>Before</td><td>After</td><td>Before</td><td>After</td></tr><tr><td>227</td><td>228</td><td>58.61</td><td>58.64</td><td>0.12</td><td>0.00</td><td>0.14</td><td>0.00</td></tr></table>								OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)		Before	After	Before	After	Before	After	Before	After	227	228	58.61	58.64	0.12	0.00	0.14	0.00	
OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)																										
Before	After	Before	After	Before	After	Before	After																									
227	228	58.61	58.64	0.12	0.00	0.14	0.00																									
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기																															

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-10TA0027	장 비 명 Equipment name	탁도계 Portable Turbidimeter	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory	작 성 Written by	확 인 Approved by
점검일자 Date	2010.08.10	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁	0653	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>							
<div>1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다.</div> <div>1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).</div>		Turbidity (NTU)							
		< 0.1		20		100		800	
		Before	After	Before	After	Before	After	Before	After
		0.17	0.06	19.0	21.0	98.0	107	794	801
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기								

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-09TA0006	장 비 명 Equipment name	수질다항목측정기 Water Quality Multiprobes	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory
점검일자 Date	2010. 08. 10	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁

작 성 Written by	확 인 Approved by
2010. 08. 10	김영수

점검요령 <i>procedure</i>	점검결과 <i>Results</i>									
<div>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다.</div> <div>1. Calibrate with a pH standard solution (pH 4, 7, 10).</div> <div>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다.</div> <div>2. Calibrate with a ORP standard solution (228 mV).</div> <div>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다.</div> <div>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</div> <div>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다.</div> <div>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂SO₃ solution.</div>	pH									
	4		7		10					
	Before	After	Before	After	Before	After				
	7.94	4.00	6.89	7.00	9.91	10.0				
	OPR (mV)				Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)	
	Before	After	Before	After	Before	After	Before	After		
	224	228	78.17	78.64	0.11	0.00	0.60	0.00		
	특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기								

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-10TA0027	장 비 명 Equipment name	탁도계 Portable Turbidimeter	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory	작 성 Written by	확 인 Approved by
점검일자 Date	2010. 08. 17	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁	06.5.08	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>							
<div>1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다.</div> <div>1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).</div>		Turbidity (NTU)							
		< 0.1		20		100		800	
		Before	After	Before	After	Before	After	Before	After
		0.06	0.08	10.0	20.0	100	101	199	807
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기								

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-09TA0006	장 비 명 Equipment name	수질다항목측정기 Water Quality Multiprobes	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory	작 성 Written by	확 인 Approved by
점검일자 Date	2010. 08. 17	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁	06.5.00	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>																															
<div>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다. <i>1. Calibrate with a pH standard solution (pH 4, 7, 10).</i></div> <div>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다. <i>2. Calibrate with a ORP standard solution (228 mV).</i></div> <div>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다. <i>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</i></div> <div>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다. <i>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂SO₃ solution.</i></div>		<table><tr><th colspan="6">pH</th></tr><tr><th colspan="2">4</th><th colspan="2">7</th><th colspan="2">10</th></tr><tr><th>Before</th><th>After</th><th>Before</th><th>After</th><th>Before</th><th>After</th></tr><tr><td>4.00</td><td>4.00</td><td>6.99</td><td>7.00</td><td>9.98</td><td>10.0</td></tr></table>								pH						4		7		10		Before	After	Before	After	Before	After	4.00	4.00	6.99	7.00	9.98	10.0
		pH																															
		4		7		10																											
		Before	After	Before	After	Before	After																										
		4.00	4.00	6.99	7.00	9.98	10.0																										
<table><tr><th colspan="2">OPR (mV)</th><th colspan="2">Conductivity (mS/cm)</th><th colspan="2">Salinity (psu)</th><th colspan="2">DO (mg/L)</th></tr><tr><th>Before</th><th>After</th><th>Before</th><th>After</th><th>Before</th><th>After</th><th>Before</th><th>After</th></tr><tr><td>227</td><td>228</td><td>58.67</td><td>58.64</td><td>0.09</td><td>0.00</td><td>0.04</td><td>0.00</td></tr></table>								OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)		Before	After	Before	After	Before	After	Before	After	227	228	58.67	58.64	0.09	0.00	0.04	0.00		
OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)																											
Before	After	Before	After	Before	After	Before	After																										
227	228	58.67	58.64	0.09	0.00	0.04	0.00																										
특기사항 <i>Remarks</i>		○ : 양호, △ : 수리 요망, X : 폐기																															

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-10TA0027	장 비 명 Equipment name	탁도계 Portable Turbidimeter	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory	작 성 Written by	확 인 Approved by
점검일자 Date	2010-08-24	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁	06700	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>							
<div>1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다.</div> <div>1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).</div>		Turbidity (NTU)							
		< 0.1		20		100		800	
		Before	After	Before	After	Before	After	Before	After
		0.10	0.07	10.0	21.0	96.0	100	194	811
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기								

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-09TA0006	장 비 명 Equipment name	수질다항목측정기 Water Quality Multiprobes	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory
점검일자 Date	2010. 08. 24	점검주기 Inspection period	The day before test	관 리 자 Manager	정 김 영 수 부 양 준 혁

작 성 Written by	확 인 Approved by
06502	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>																													
<div>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다. <i>1. Calibrate with a pH standard solution (pH 4, 7, 10).</i></div> <div>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다. <i>2. Calibrate with a ORP standard solution (228 mV).</i></div> <div>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다. <i>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</i></div> <div>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다. <i>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂SO₃ solution.</i></div>		<div>pH</div> <table><tr><td colspan="2">4</td><td colspan="2">7</td><td colspan="2">10</td></tr><tr><td>Before</td><td>After</td><td>Before</td><td>After</td><td>Before</td><td>After</td></tr><tr><td>7.84</td><td>4.00</td><td>6.99</td><td>7.00</td><td>9.98</td><td>10.0</td></tr></table>								4		7		10		Before	After	Before	After	Before	After	7.84	4.00	6.99	7.00	9.98	10.0				
		4		7		10																									
		Before	After	Before	After	Before	After																								
		7.84	4.00	6.99	7.00	9.98	10.0																								
		<div></div> <table><tr><td colspan="2">OPR (mV)</td><td colspan="2">Conductivity (mS/cm)</td><td colspan="2">Salinity (psu)</td><td colspan="2">DO (mg/L)</td></tr><tr><td>Before</td><td>After</td><td>Before</td><td>After</td><td>Before</td><td>After</td><td>Before</td><td>After</td></tr><tr><td>228</td><td>228</td><td>58.61</td><td>58.64</td><td>0.05</td><td>0.00</td><td>0.10</td><td>0.00</td></tr></table>								OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)		Before	After	Before	After	Before	After	Before	After	228	228	58.61	58.64	0.05	0.00
OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)																									
Before	After	Before	After	Before	After	Before	After																								
228	228	58.61	58.64	0.05	0.00	0.10	0.00																								
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기																														

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 <i>Serial No.</i>	KOMERI-10TA0027	장 비 명 <i>Equipment name</i>	탁도계 Portable Turbidimeter	설치장소 <i>Installation Location</i>	수중생물학시험실 <i>Microbiology laboratory</i>		작 성 <i>Written by</i>	확 인 <i>Approved by</i>
점검일자 <i>Date</i>	2010. 08. 27	점검주기 <i>Inspection period</i>	The day before test	관 리 자 <i>Manager</i>	정 부	김 영 수 양 준 혁	06500	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>							
<p>1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다.</p> <p>1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).</p>		Turbidity (NTU)							
		< 0.1		20		100		800	
		Before	After	Before	After	Before	After	Before	After
		0.04	0.07	19.0	20.0	100	101	801	804
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기								

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-09TA0006	장 비 명 Equipment name	수질다항목측정기 Water Quality Multiprobes	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory
점검일자 Date	2010. 08. 27	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁

작 성 Written by	확 인 Approved by
06400	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>																															
<div>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다. <i>1. Calibrate with a pH standard solution (pH 4, 7, 10).</i></div> <div>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다. <i>2. Calibrate with a ORP standard solution (228 mV).</i></div> <div>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다. <i>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</i></div> <div>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다. <i>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂SO₃ solution.</i></div>		<table><tr><th colspan="6">pH</th></tr><tr><th colspan="2">4</th><th colspan="2">7</th><th colspan="2">10</th></tr><tr><th>Before</th><th>After</th><th>Before</th><th>After</th><th>Before</th><th>After</th></tr><tr><td>7.96</td><td>4.00</td><td>11.01</td><td>7.00</td><td>9.96</td><td>10.0</td></tr></table>								pH						4		7		10		Before	After	Before	After	Before	After	7.96	4.00	11.01	7.00	9.96	10.0
		pH																															
		4		7		10																											
		Before	After	Before	After	Before	After																										
		7.96	4.00	11.01	7.00	9.96	10.0																										
<table><tr><th colspan="2">OPR (mV)</th><th colspan="2">Conductivity (mS/cm)</th><th colspan="2">Salinity (psu)</th><th colspan="2">DO (mg/L)</th></tr><tr><th>Before</th><th>After</th><th>Before</th><th>After</th><th>Before</th><th>After</th><th>Before</th><th>After</th></tr><tr><td>226</td><td>228</td><td>58.61</td><td>58.64</td><td>0.01</td><td>0.00</td><td>0.04</td><td>0.00</td></tr></table>								OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)		Before	After	Before	After	Before	After	Before	After	226	228	58.61	58.64	0.01	0.00	0.04	0.00		
OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)																											
Before	After	Before	After	Before	After	Before	After																										
226	228	58.61	58.64	0.01	0.00	0.04	0.00																										
특기사항 <i>Remarks</i>		○ : 양호, △ : 수리 요망, X : 폐기																															

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-10TA0027	장 비 명 Equipment name	탁도계 Portable Turbidimeter	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory	작 성 Written by	확 인 Approved by
점검일자 Date	2010. 09. 08	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁	06.5.08	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>							
<div>1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다.</div> <div>1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).</div>		Turbidity (NTU)							
		< 0.1		20		100		800	
		Before	After	Before	After	Before	After	Before	After
		0.09	0.09	19.0	20.0	98.0	100	998	801
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기								

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-09TA0006	장 비 명 Equipment name	수질다항목측정기 Water Quality Multiprobes	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory
점검일자 Date	2010. 09. 08	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁

작 성 Written by	확 인 Approved by
06500	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>							
<div>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다. <i>1. Calibrate with a pH standard solution (pH 4, 7, 10).</i></div> <div>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다. <i>2. Calibrate with a ORP standard solution (228 mV).</i></div> <div>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다. <i>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</i></div> <div>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다. <i>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂SO₃ solution.</i></div>		pH							
		4		7		10			
		Before	After	Before	After	Before	After		
		71.96	4.00	6.91	7.00	9.99	10.0		
		OPR (mV)							
		Before		After		Before		After	
		219		228		58.60		58.64	
</									

장 비 중 간 점 검 기 록 서

Equipment check records

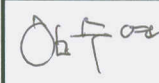
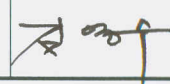
관리번호 Serial No.	KOMERI-10TA0027	장 비 명 Equipment name	탁도계 Portable Turbidimeter	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory		작 성 Written by	확 인 Approved by
점검일자 Date	2010. 09. 17	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부	김 영 수 양 준 혁	0652	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>							
1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이용하여 Turbidimeter 센서를 보정한다. 1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).		Turbidity (NTU)							
		< 0.1		20		100		800	
		Before	After	Before	After	Before	After	Before	After
		0.08	0.07	19.0	20.0	98.0	100	779	798
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기								

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-09TA0006	장 비 명 Equipment name	수질다항목측정기 Water Quality Multiprobes	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory
점검일자 Date	2010. 09. 12	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁

작 성 Written by	확 인 Approved by
	

점검요령 <i>procedure</i>		점검결과 <i>Results</i>																															
<div>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다. <i>1. Calibrate with a pH standard solution (pH 4, 7, 10).</i></div> <div>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다. <i>2. Calibrate with a ORP standard solution (228 mV).</i></div> <div>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다. <i>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</i></div> <div>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂So₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다. <i>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂So₃ solution.</i></div>		<div>pH</div> <table><tr><td colspan="2">4</td><td colspan="2">7</td><td colspan="2">10</td></tr><tr><td>Before</td><td>After</td><td>Before</td><td>After</td><td>Before</td><td>After</td></tr><tr><td>7.96</td><td>4.00</td><td>6.98</td><td>7.00</td><td>10.0</td><td>10.0</td></tr></table>								4		7		10		Before	After	Before	After	Before	After	7.96	4.00	6.98	7.00	10.0	10.0						
		4		7		10																											
		Before	After	Before	After	Before	After																										
		7.96	4.00	6.98	7.00	10.0	10.0																										
		<div></div> <table><tr><td colspan="2">OPR (mV)</td><td colspan="2">Conductivity (mS/cm)</td><td colspan="2">Salinity (psu)</td><td colspan="2">DO (mg/L)</td></tr><tr><td>Before</td><td>After</td><td>Before</td><td>After</td><td>Before</td><td>After</td><td>Before</td><td>After</td></tr><tr><td>226</td><td>228</td><td>58.00</td><td>58.64</td><td>0.10</td><td>0.00</td><td>0.04</td><td>0.00</td></tr></table>								OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)		Before	After	Before	After	Before	After	Before	After	226	228	58.00	58.64	0.10	0.00	0.04	0.00
		OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)																									
		Before	After	Before	After	Before	After	Before	After																								
		226	228	58.00	58.64	0.10	0.00	0.04	0.00																								
		특기사항 <i>Remarks</i>		○ : 양호, △ : 수리 요망, X : 폐기																													

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 <i>Serial No.</i>	KOMERI-10TA0027	장 비 명 <i>Equipment name</i>	탁도계 Portable Turbidimeter	설치장소 <i>Installation Location</i>	수중생물학시험실 Microbiology laboratory		작 성 <i>Written by</i>	확 인 <i>Approved by</i>
점검일자 <i>Date</i>	2010. 09. 14	점검주기 <i>Inspection period</i>	The day before test	관 리 자 <i>Manager</i>	정 부	김 영 수 양 준 혁	06-5-0000	김영수

점검요령 <i>procedure</i>	점검결과 <i>Results</i>																																
<p>1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다.</p> <p>1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).</p>	<table border="1"> <tr> <th colspan="8">Turbidity (NTU)</th> </tr> <tr> <th colspan="2">< 0.1</th> <th colspan="2">20</th> <th colspan="2">100</th> <th colspan="2">800</th> </tr> <tr> <th>Before</th> <th>After</th> <th>Before</th> <th>After</th> <th>Before</th> <th>After</th> <th>Before</th> <th>After</th> </tr> <tr> <td>0.09</td> <td>0.07</td> <td>20.0</td> <td>21.0</td> <td>98.0</td> <td>100</td> <td>196</td> <td>198</td> </tr> </table>	Turbidity (NTU)								< 0.1		20		100		800		Before	After	Before	After	Before	After	Before	After	0.09	0.07	20.0	21.0	98.0	100	196	198
Turbidity (NTU)																																	
< 0.1		20		100		800																											
Before	After	Before	After	Before	After	Before	After																										
0.09	0.07	20.0	21.0	98.0	100	196	198																										
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기																																

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 <i>Serial No.</i>	KOMERI-09TA0006	장 비 명 <i>Equipment name</i>	수질다항목측정기 Water Quality Multiprobes	설치장소 <i>Installation Location</i>	수중생물학시험실 Microbiology laboratory
점검일자 <i>Date</i>	2010. 09. 14	점검주기 <i>Inspection period</i>	The day before test	관 리 자 <i>Manager</i>	정 부 김 영 수 양 준 혁

작 성 <i>Written by</i>	확 인 <i>Approved by</i>
Okdyeon	김영수

점검요령 <i>procedure</i>	점검결과 <i>Results</i>							
<p>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다.</p> <p>1. Calibrate with a pH standard solution (pH 4, 7, 10).</p> <p>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다.</p> <p>2. Calibrate with a ORP standard solution (228 mV).</p> <p>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다.</p> <p>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</p> <p>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다.</p> <p>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂SO₃ solution.</p>	pH							
	4		7		10			
	Before	After	Before	After	Before	After		
	7.96	4.00	6.99	7.00	11.89	10.0		
	OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)	
	Before	After	Before	After	Before	After	Before	After
	226	228	58.63	58.64	0.01	0.00	0.07	0.00
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기							

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-10TA0027	장 비 명 Equipment name	탁도계 Portable Turbidimeter	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory	작 성 Written by	확 인 Approved by
점검일자 Date	2010.09.17	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁	0650	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>							
1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이용하여 Turbidimeter 센서를 보정한다. 1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).		Turbidity (NTU)							
		< 0.1		20		100		800	
		Before	After	Before	After	Before	After	Before	After
		0.06	0.07	19.0	20.0	98.0	101	198	808
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기								

장 비 중 간 점 검 기 록 서

Equipment check records



관리번호 Serial No.	KOMERI-09TA0006	장 비 명 Equipment name	수질다항목측정기 Water Quality Multiprobes	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory
점검일자 Date	2010. 09. 17	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁

작 성 Written by	확 인 Approved by
06502	김영수

점검요령 procedure		점검결과 Results																															
<div>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다. <i>1. Calibrate with a pH standard solution (pH 4, 7, 10).</i></div> <div>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다. <i>2. Calibrate with a ORP standard solution (228 mV).</i></div> <div>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다. <i>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</i></div> <div>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다. <i>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂SO₃ solution.</i></div>		<table><tr><th colspan="6">pH</th></tr><tr><th colspan="2">4</th><th colspan="2">7</th><th colspan="2">10</th></tr><tr><td>Before</td><td>After</td><td>Before</td><td>After</td><td>Before</td><td>After</td></tr><tr><td>7.89</td><td>8.00</td><td>6.98</td><td>7.00</td><td>9.94</td><td>10.0</td></tr></table>								pH						4		7		10		Before	After	Before	After	Before	After	7.89	8.00	6.98	7.00	9.94	10.0
		pH																															
		4		7		10																											
		Before	After	Before	After	Before	After																										
		7.89	8.00	6.98	7.00	9.94	10.0																										
<table><tr><th colspan="2">OPR (mV)</th><th colspan="2">Conductivity (mS/cm)</th><th colspan="2">Salinity (psu)</th><th colspan="2">DO (mg/L)</th></tr><tr><td>Before</td><td>After</td><td>Before</td><td>After</td><td>Before</td><td>After</td><td>Before</td><td>After</td></tr><tr><td>226</td><td>228</td><td>58.60</td><td>58.64</td><td>0.01</td><td>0.00</td><td>0.01</td><td>0.00</td></tr></table>								OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)		Before	After	Before	After	Before	After	Before	After	226	228	58.60	58.64	0.01	0.00	0.01	0.00		
OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)																											
Before	After	Before	After	Before	After	Before	After																										
226	228	58.60	58.64	0.01	0.00	0.01	0.00																										
특기사항 Remarks		○ : 양호, △ : 수리 요망, X : 폐기																															

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 <i>Serial No.</i>	KOMERI-10TA0027	장 비 명 <i>Equipment name</i>	탁도계 Portable Turbidimeter	설치장소 <i>Installation Location</i>	수중생물학시험실 Microbiology laboratory		작 성 <i>Written by</i>	확 인 <i>Approved by</i>
점검일자 <i>Date</i>	2010. 09. 28	점검주기 <i>Inspection period</i>	The day before test	관 리 자 <i>Manager</i>	정 부	김 영 수 양 준 혁		

점검요령 <i>procedure</i>	점검결과 <i>Results</i>																																
<p>1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다.</p> <p>1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).</p>	<table border="1"> <tr> <th colspan="8">Turbidity (NTU)</th> </tr> <tr> <th colspan="2">< 0.1</th> <th colspan="2">20</th> <th colspan="2">100</th> <th colspan="2">800</th> </tr> <tr> <th>Before</th> <th>After</th> <th>Before</th> <th>After</th> <th>Before</th> <th>After</th> <th>Before</th> <th>After</th> </tr> <tr> <td>0.09</td> <td>0.07</td> <td>19.0</td> <td>20.0</td> <td>96.0</td> <td>98.0</td> <td>792</td> <td>801</td> </tr> </table>	Turbidity (NTU)								< 0.1		20		100		800		Before	After	Before	After	Before	After	Before	After	0.09	0.07	19.0	20.0	96.0	98.0	792	801
Turbidity (NTU)																																	
< 0.1		20		100		800																											
Before	After	Before	After	Before	After	Before	After																										
0.09	0.07	19.0	20.0	96.0	98.0	792	801																										
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기																																

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 <i>Serial No.</i>	KOMERI-09TA0006	장 비 명 <i>Equipment name</i>	수질다항목측정기 Water Quality Multiprobes	설치장소 <i>Installation Location</i>	수중생물학시험실 Microbiology laboratory
점검일자 <i>Date</i>	2010. 09. 28	점검주기 <i>Inspection period</i>	The day before test	관 리 자 <i>Manager</i>	정 김 영 수 부 양 준 혁

작 성 <i>Written by</i>	확 인 <i>Approved by</i>
06.5.02	김영수

점검요령 <i>procedure</i>	점검결과 <i>Results</i>							
1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다. 1. Calibrate with a pH standard solution (pH 4, 7, 10). 2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다. 2. Calibrate with a ORP standard solution (228 mV). 3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다. 3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water. 4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na ₂ SO ₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다. 4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na ₂ SO ₃ solution.	pH							
	4		7		10			
	Before	After	Before	After	Before	After		
	7.89	4.00	6.91	7.00	9.91	10.0		
OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)		
Before	After	Before	After	Before	After	Before	After	
228	228	58.67	58.64	0.01	0.00	0.07	0.00	
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기							

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-10TA0027	장 비 명 Equipment name	탁도계 Portable Turbidimeter	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory		작 성 Written by	확 인 Approved by
점검일자 Date	2010. 10. 01	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부	김 영 수 양 준 혁	06.5.20	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>							
1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다. 1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).		Turbidity (NTU)							
		< 0.1		20		100		800	
		Before	After	Before	After	Before	After	Before	After
		0.01	0.01	20.0	20.0	96.0	98.0	90.1	80.3
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기								

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-09TA0006	장 비 명 Equipment name	수질다항목측정기 Water Quality Multiprobes	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory
점검일자 Date	2010. 10. 01	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁

작 성 Written by	확 인 Approved by
06-500	[Signature]

점검요령 procedure		점검결과 Results							
<p>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다.</p> <p>1. Calibrate with a pH standard solution (pH 4, 7, 10).</p> <p>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다.</p> <p>2. Calibrate with a ORP standard solution (228 mV).</p> <p>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다.</p> <p>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</p> <p>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다.</p> <p>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂So₃ solution.</p>		pH							
		4		7		10			
		Before	After	Before	After	Before	After		
		4.01	4.00	7.07	7.00	10.1	10.0		
		OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)	
		Before	After	Before	After	Before	After	Before	After
		227	228	58.61	58.64	0.07	0.00	0.01	0.00
특기사항 Remarks		○ : 양호, △ : 수리 요망, X : 폐기							

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-10TA0027	장 비 명 Equipment name	탁도계 Portable Turbidimeter	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory		작 성 Written by	확 인 Approved by
점검일자 Date	2010. 10. 07	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부	김 영 수 양 준 혁	06500	김영수

점검요령 procedure	점검결과 Results																																
<p>1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다.</p> <p>1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).</p>	<table border="1"> <thead> <tr> <th colspan="8">Turbidity (NTU)</th> </tr> <tr> <th colspan="2">< 0.1</th> <th colspan="2">20</th> <th colspan="2">100</th> <th colspan="2">800</th> </tr> <tr> <th>Before</th> <th>After</th> <th>Before</th> <th>After</th> <th>Before</th> <th>After</th> <th>Before</th> <th>After</th> </tr> </thead> <tbody> <tr> <td>0.08</td> <td>0.06</td> <td>19.0</td> <td>21.0</td> <td>101</td> <td>107</td> <td>801</td> <td>810</td> </tr> </tbody> </table>	Turbidity (NTU)								< 0.1		20		100		800		Before	After	Before	After	Before	After	Before	After	0.08	0.06	19.0	21.0	101	107	801	810
Turbidity (NTU)																																	
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0.08	0.06	19.0	21.0	101	107	801	810																										
특기사항 Remarks	○ : 양호, △ : 수리 요망, X : 폐기																																

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-09TA0006	장 비 명 Equipment name	수질다항목측정기 Water Quality Multiprobes	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory	작 성 Written by	확 인 Approved by
점검일자 Date	2010. 10. 05	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁	Oh Young-soo	Yang Jun-hyeok

점검요령 <i>procedure</i>		점검결과 <i>Results</i>																															
<div>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다. <i>1. Calibrate with a pH standard solution (pH 4, 7, 10).</i></div> <div>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다. <i>2. Calibrate with a ORP standard solution (228 mV).</i></div> <div>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다. <i>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</i></div> <div>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다. <i>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂SO₃ solution.</i></div>		<table><tr><th colspan="6">pH</th></tr><tr><th colspan="2">4</th><th colspan="2">7</th><th colspan="2">10</th></tr><tr><td>Before</td><td>After</td><td>Before</td><td>After</td><td>Before</td><td>After</td></tr><tr><td>7.96</td><td>4.00</td><td>6.91</td><td>7.00</td><td>9.88</td><td>10.0</td></tr></table>								pH						4		7		10		Before	After	Before	After	Before	After	7.96	4.00	6.91	7.00	9.88	10.0
		pH																															
		4		7		10																											
		Before	After	Before	After	Before	After																										
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OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)																											
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장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 <i>Serial No.</i>	KOMERI-10TA0027	장 비 명 <i>Equipment name</i>	탁도계 Portable Turbidimeter	설치장소 <i>Installation Location</i>	수중생물학시험실 <i>Microbiology laboratory</i>		작 성 <i>Written by</i>	확 인 <i>Approved by</i>
점검일자 <i>Date</i>	2010. 10. 08	점검주기 <i>Inspection period</i>	The day before test	관 리 자 <i>Manager</i>	정 부	김 영 수 양 준 혁	06.10.08	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>							
<p>1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다.</p> <p>1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).</p>		Turbidity (NTU)							
		< 0.1		20		100		800	
		Before	After	Before	After	Before	After	Before	After
		0.09	0.07	19.0	20.0	98.0	101	801	804
특기사항 <i>Remarks</i>	○ : 양호, △ : 수리 요망, X : 폐기								

장비 중간 점검 기록서

Equipment check records

관리번호 Serial No.	KOMERI-09TA0006	장비명 Equipment name	수질다항목측정기 Water Quality Multiprobes	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory
점검일자 Date	2010.10.08	점검주기 Inspection period	The day before test	관리자 Manager	정 김 영 수 부 양 준 혁

작성 Written by	확인 Approved by
Ok-500	김영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>									
<div>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다. <i>1. Calibrate with a pH standard solution (pH 4, 7, 10).</i></div> <div>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다. <i>2. Calibrate with a ORP standard solution (228 mV).</i></div> <div>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다. <i>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</i></div> <div>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다. <i>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂SO₃ solution.</i></div>		pH									
		4		7		10					
		Before	After	Before	After	Before	After				
		7.99	4.00	6.98	7.00	9.97	10.0				
		OPR (mV)				Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)	
		Before	After	Before	After	Before	After	Before	After		
		228	228	58.60	58.64	0.01	0.00	0.10	0.00		
		특기사항 <i>Remarks</i>		○ : 양호, △ : 수리 요망, X : 폐기							

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-10TA0027	장 비 명 Equipment name	탁도계 Portable Turbidimeter	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory		작 성 Written by	확 인 Approved by
점검일자 Date	2011. 06. 16	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부	김 영 수 양 준 혁	06.16.11	김영수

점검요령 procedure	점검결과 Results																																
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장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-09TA0006	장 비 명 Equipment name	수질다항목측정기 Water Quality Multiprobes	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory
점검일자 Date	2011. 06. 16	점검주기 Inspection period	The day before test	관 리 자 Manager	정 부 김 영 수 양 준 혁

작 성 Written by	확 인 Approved by
06500	지영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>																															
<div>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다. <i>1. Calibrate with a pH standard solution (pH 4, 7, 10).</i></div> <div>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다. <i>2. Calibrate with a ORP standard solution (228 mV).</i></div> <div>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다. <i>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</i></div> <div>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다. <i>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂SO₃ solution.</i></div>		<table><tr><th colspan="6">pH</th></tr><tr><th colspan="2">4</th><th colspan="2">7</th><th colspan="2">10</th></tr><tr><th>Before</th><th>After</th><th>Before</th><th>After</th><th>Before</th><th>After</th></tr><tr><td>4.00</td><td>4.00</td><td>6.94</td><td>7.00</td><td>9.89</td><td>10.0</td></tr></table>								pH						4		7		10		Before	After	Before	After	Before	After	4.00	4.00	6.94	7.00	9.89	10.0
		pH																															
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OPR (mV)		Conductivity (mS/cm)		Salinity (psu)		DO (mg/L)																											
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226	228	58.62	58.64	0.06	0.00	0.10	0.00																										
특기사항 <i>Remarks</i>		○ : 양호, △ : 수리 요망, X : 폐기																															

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 <i>Serial No.</i>	KOMERI-10TA0027	장 비 명 <i>Equipment name</i>	탁도계 Portable Turbidimeter	설치장소 <i>Installation Location</i>	수중생물학시험실 <i>Microbiology laboratory</i>		작 성 <i>Written by</i>	확 인 <i>Approved by</i>
점검일자 <i>Date</i>	2011. 06. 21	점검주기 <i>Inspection period</i>	The day before test	관 리 자 <i>Manager</i>	정 부	김 영 수 양 준 혁	06500	정영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>							
<p>1. Formazin standard solution (<0.1, 20, 100, 800 NTU) 을 이 용하여 Turbidimeter 센서를 보정한다.</p> <p>1. Calibrate with a formazin standard solution (<0.1, 20, 100, 800 NTU).</p>		Turbidity (NTU)							
		< 0.1		20		100		800	
		Before	After	Before	After	Before	After	Before	After
		0.09	0.06	20.0	21.0	101	101	801	807
특기사항 <i>Remarks</i>		○ : 양호, △ : 수리 요망, X : 폐기							

장 비 중 간 점 검 기 록 서

Equipment check records

관리번호 Serial No.	KOMERI-09TA0006	장 비 명 Equipment name	수질다항목측정기 Water Quality Multiprobes	설치장소 Installation Location	수중생물학시험실 Microbiology laboratory
점검일자 Date	2011. 06-21	점검주기 Inspection period	The day before test	관 리 자 Manager	정 김 영 수 부 양 준 혁

작 성 Written by	확 인 Approved by
06500	정영수

점검요령 <i>procedure</i>		점검결과 <i>Results</i>																															
<div>1. pH standard solution (pH 4, 7, 10) 을 이용하여 pH 센서를 보정한다. <i>1. Calibrate with a pH standard solution (pH 4, 7, 10).</i></div> <div>2. ORP standard solution (228 mV) 을 이용하여 ORP 센서를 보정한다. <i>2. Calibrate with a ORP standard solution (228 mV).</i></div> <div>3. Specific conductance standard solution (58.64 mS/cm) 을 이용하여 Conductivity 센서를 보정한 후, 초순수를 이용하여 Salinity 값이 0 psu를 읽는지 확인한다. <i>3. Calibrate with a specific conductance standard solution (58.64 mS/cm) and then confirm (0 psu) with Ultrapure water.</i></div> <div>4. DO 센서의 보정은 대기압 (760 mmHg) 을 이용하여 보정한 후, Na₂SO₃ 포화수용액을 이용하여 DO (mg/L) 값이 0 mg/L 을 읽는지 확인한다. <i>4. Calibrate in the atmosphere (ambient condition), and then confirm (0 mg/L) with saturated Na₂So₃ solution.</i></div>		<table><tr><th colspan="6">pH</th></tr><tr><th colspan="2">4</th><th colspan="2">7</th><th colspan="2">10</th></tr><tr><td>Before</td><td>After</td><td>Before</td><td>After</td><td>Before</td><td>After</td></tr><tr><td>7.44</td><td>4.00</td><td>6.97</td><td>7.00</td><td>9.98</td><td>10.0</td></tr></table>								pH						4		7		10		Before	After	Before	After	Before	After	7.44	4.00	6.97	7.00	9.98	10.0
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